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THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXXIII.—No. 5. Whole No. 509. | NEW YORK, THURSDAY, SEPTEMBER 2, 1880. | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, C.E., Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European Countries, $3.50 (15 shillings—18 francs). All payments to be made in advance. Single copies, 15 cents.

Remittances should be made either by post-office order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

The American News Company, Nos. 39 and 41 Chambers Street, New York, are agents for this Journal. Newsdealers will send orders to them.

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[OFFICIAL NOTICE.]

OFFICE OF CENTRAL N. Y. GAS ENGINEERS' ASSOCIATION, August 27th, 1880.

The regular semi-annual meeting of this Association will be held at Bradford, Pa., on the third Wednesday of September (the 22d). Headquarters at the St. James Hotel.

C. A. WHITE, *Secretary.*

[OFFICIAL NOTICE.]

OFFICE AMERICAN GAS LIGHT ASSOCIATION, 142 CHAMBERS STREET, NEW YORK.

To the Members of the Association:

The VIII. Annual Meeting of the Association will be held in the city of Chicago, on the 13th, 14th and 15th days of October next.

Headquarters have been secured at the Grand Pacific Hotel, with a uniform rate of board for members at $2.50 per day. The meetings will be held in the large hall of the hotel.

The present indications point to an unusually interesting and instructive meeting. A full attendance of members is earnestly urged. Members who intend to present papers, and have not yet notified the Secretary to that effect, will please do so at an early date.

In order that the Committee of Arrangements—E. T. Watkins, President Chicago Gas Light and Coke Company, chairman—may be informed of the number who will be present at the meeting, and provide for the comfort of all, each member who expects to attend will confer a favor by notifying this office of that fact at as early a day as possible.

Officers of gas companies who are not members of the Association will find it to their interest to take advantage of the approaching meeting and send in their names for election as members. Blank applications may be had at any time at this office, or in Chicago during the sessions of the Association.

Efforts are being made to secure excursion rates for members who can start for Chicago from this city, due notice of which will be given when a decision has been reached by the railway managers.

WM. HENRY WHITE, *Secretary.*

SEMI-ANNUAL MEETING OF THE NEW ENGLAND GAS ENGINEERS' ASSOCIATION.

The usual Semi-Annual Meeting of this Association was held this year at North Adams, Mass., and the occasion proved to be one of a most enjoyable kind.

It has been the custom heretofore to go to some place on the seashore, but the committee having charge of the matter this year, after careful consideration of the subject, concluded to try mountain air instead of salt water, and the result was very satisfactory to all that attended. On the morning of the 18th ult., the party composed of those residing in the eastern portion of New England left in a special car, which was kindly provided by the Fitchburg Railroad Company, and proceeded by the Hoosac Tunnel route to North Adams, where they arrived about 1 P.M. The number of ladies in the party was unusually large, and to this fact must be attributed much of the pleasure of the trip.

The car occupied by the party was a new one, and was so exceedingly comfortable and easy that one could hardly realize that he was in motion. Every one was in good spirits and the ride will be long remembered by all. North Adams itself is a busy, bustling little place of about 12,000 inhabitants, and is nestled down among the hills just at the foot of the Hoosac mountain, and only two or three miles from the western end of the great tunnel; it is an exceedingly pleasant town, and is the centre of a large manufacturing industry which is scattered among the hills on the water courses that pass through the place.

The Wilson House was the place selected by the committee for headquas-

ters, and upon arrival there the party was joined by a number who had come from other directions than the east. Among those who enjoyed the whole trip the most, the ladies seemed to be particularly delighted. The committee of arrangements again proved to all their sagacity in such matters in the selection they had made for headquarters. Events proved that the proprietor knows how to keep a hotel, and, in fact, he knows how to keep two hotels, for the Greylock Hall, at Williamstown is under the same management as the Wilson House.

After the necessary preparation for dinner the members, and the ladies accompanying them, assembled in the parlors where they were met by Mr. Richardson, of the North Adams Gas Light Company, and quite a number of ladies and gentlemen residing in the town, who extended to the members and their ladies a most cordial welcome, and after a few moment's of friendly exchange of greetings they all sat down to dinner.

At half-past three carriages for a mountain drive were in readiness and all arranged themselves in the way best suiting their tastes, some in large vehicles drawn by four horses, some in others with double teams, while those desiring to do their own driving were accommodated with single ones. The climb to the top of Hoosac mountain, although somewhat slow, was one well worth the whole trip. The views that opened from the different points, as the party went winding and zigzagging up the mountain side were simply superb, while the constant change of the same scene, as viewed from different points, and from different directions, made it appear like one continued succession of panoramic views. At last the top was reached, and the drive continued to the "eastern summit," where another most superb view lay spread out before them.

At the base of the hill was the eastern entrance of the tunnel, and down the valley could be seen the river and the railroad winding along together till lost in the interlocking hills beyond. Far as the eye could reach was spread out one of those delightful mountain landscapes made more picturesque and more wild by the lengthening shadows of the setting sun. The air was clear, and on one hand could be seen the towering top of Mount Monadnock, while to the southward the eye lost its vision in the distant haze of the smaller hills. With lingering glances at the beautiful scene the party remounted and began to retrace their way. Arriving at the western summit the valley below was spread out with all its natural beauty tinged with the purple and golden tints of sunset. Villages appeared and disappeared as the party descended, and one point after another was brought to view and lost again by the winding of the way. There was one thing that added much to the pleasure of the trip, for it dispelled all idea of danger from the minds of those naturally disposed to be somewhat timid, and that was the skill of the drivers.

Perhaps, on parade, the "coaching club" might present a more "swell" appearance, and their carefully trained horses may prance and step in better style; but it is a question if they could make the trip over the Hoosac mountain with anything like the skill, ease, and safety that was displayed by these knights of the whip, whose only knowledge of a "coach" is derived from the stories they have heard their fathers tell of the "good old stage days" when, from Troy to Boston was done in an old-fashioned coach over the same mountain that this excursion was made.

The hotel was reached without a mishap or break of any kind, and not only was supper ready for the party but the party was ready for supper. In the evening the business meeting was held in one of the rooms of the hotel. The chair was occupied by Mr. Wm. A. Stedman, President of the Association. The reading of the minutes of the last meeting was dispensed with, they having been already published in the AMERICAN GAS LIGHT JOURNAL, and in the pamphlet form which had been furnished each member, A formal vote of thanks was passed to the committee on publication and to the committee on statistics, for their labors in behalf of the Association. A hearty vote of thanks was also passed to the committee of arrangements for the present meeting, who had so perfectly anticipated and provided for every want of the members, and been so successful in making every arrangement for the comfort of the members and their friends.

It is not usual to transact much formal business at the semi-annual meeting, and the evening was spent in an informal discussion of various matters of professional interest. Quite a number of important trials of apparatus were reported as in progress, especially in the method of heating benches, and by the time the next meeting occurs in February it is probable that results will have been reached which will render that meeting one of the most interesting ever held by the Association. The Secretary of the American Gas Light Association, Capt. W. H. White, upon beigg introduced to the meeting, said that he desired to explain why it had become necessary to appoint the day of meeting of the National Association on the second instead of the 3d Wednesday of October next.

It was found that during the 3d week in October there would be conventions of two other large associations held in Chicago, and that both the Palmer House and the Grand Pacific Hotel would be unable to accommodate the Gas Light Association during that week. In addition to this fact the local committee of arrangements were of the opinion that much better weather would be likely to occur in the second than in the the third week, and they deemed this a very important point. In view of these facts, Capt. White said that the Executive Committee of the American Association had unanimously decided that the best interests of the Association demanded of them to arrange for the meeting on the 13th, 14th, and 15th of October. The Captain urged upon every one the necessity of contributing their share to the success of the next meeting, and expressed a confident hope that he should not be disappointed in the part that would be taken by the members from New England.

The meeting adjourned, and the members rejoined the ladies who had been holding a separate meeting in the parlors.

The second day, Thursday, appeared to threaten rain, and the programme of the day was slightly modified, so as to enable the members to dine at the Wilson House instead of Greylock Hall. Most of the party, however, as the clouds cleared away, took conveyances and drove through Williamstown to Greylock Hall and back in time for dinner. The principal item of gas interest at Greylock Hall was a gas machine, which, it was claimed, would made 1000 feet of gas from seven gallons of oil without any admixture of air. This was thought by some to be a wonderful statement; but the operator of the machine was positive he could "do it every time." After dinner at the Wilson House, the party assembled in the parlor, a very happy address to the proprietor of the hotels was delivered by Capt. White, and a large floral tribute was given him on behalf of the ladies, all of which was acknowledged by brother Swift in a very short and appropriate speech. A special vote of thanks was unanimously passed to Mr. Fred Davis, of Waltham, for his labors on behalf of the committee in securing the special car, the reduced rates of railroad fare, and in making arrangements for the comfort and convenience of the party.

At four o'clock the party took the train for Boston, where all arrived in safety, well pleased with the semi-annual meeting in the mountains.

Letter from Mr. Briggs on the London Explosion.

Mr. Editor: In the reports of the trial before the Coroner's jury into the the great gas explosion in London, as copied into your last number, it does not seem that any investigation was made into the conditions of laying of the half mile of 36-inch main involved in the accident. It would have been much to the purpose if the levels of this line had been exhibited. From two or three instances in my own knowledge it has become impressed upon me that the explosive mixture of a portion of gas and air or, more probably, gas and oxygen forms where there is a much less quantity of gas within a room or space than would, if entirely diffused, be at all dangerous. This condition at least is established in the upper part of a space, and is not disturbed by diffusion downwards.

Some few years since there was an explosion at the mint in this city, killing, I think, two if not three men. Here the explosive mixture was in the upper part of a brick arched vault where the doorway had been open and persons had used the vault freely for two or more days. A broken pendant the gas to which had been cut off for such time was the cause of the accident; only a slight smell of gas existed at the floor. In two cases I have known disastrous explosions of disused holders from explosive mixtures in the crown above the manhole openings. One of these had had the manhole off and a dry tank for some months.

The description of the accident in London, as testified to, seems to indicate the existence of traps of explosixe mixtures joined by a stratum of mixture suitable to communicate ignition, and it would have been well to trace out the possibility of this state of things.

Notwithstanding the fearful extent of this disaster, yet it is quite insignificant to the ruin to have been expected if the pipe had been fully charged with explosive mixture. Had this been the case there would have been no witnesses to testify how it happened. Yours,

ROBERT BRIGGS, C.E.

PHILA., PA., August 20, 1880.

Leeds (England) Corporation Gas Supply.

At the Meeting of the Leeds Town Council, Wednesday, August 11th, the question of reducing the price of gas came up for discussion and settlement.

Alderman Bower, the Chairman of the Gas Committee, moved—

"That the price of gas be reduced from 2s. 2d. to 1s. 10d. per 1000 cubic feet, such reduction to take effect from July 1st, 1880."

Mr. Nicholson seconded the motion.

After various amendments had been proposed and rejected, a vote on the original resolution resulted in its being carried by 15 votes to 10.—*Journal of Gas Lighting.*

Gas Matters in Charleston, S. C.

We take the following from Charleston papers:

NOTICE ISSUED BY A NEW COMPANY.

Notice of a meeting of members of the "Municipal Gas Manufacturing Company of Charleston, S. C."—A meeting of the members of the Municipal Gas Manufacturing Company of Charleston, S. C., for the purpose of organization, adoption of by-laws, and the election of President, Board of Directors, Clerk, Treasurer, and General Superintendent, and the transaction of other necessary business, will be held at the office of T. Moultrie Mordecai, 26 Broad street, Charleston, S. C., on Thursday, July 1st, 1880, at 10 o'clock A.M., in accordance with the Acts of the General Assembly in such case made and provided.

CORNELIUS DONKERSLEY,
CHARLES W. KOHLSAAT,
A. H. LAZARE,
GEORGE MANLEY,
J. L. HOBSON,

For themselves and other members of the Municipal Gas Manufacturing Company of Charleston, S. C.

ORGANIZATION OF THE NEW COMPANY.

CHARLESTON, S. C., July 2, 1880.

The Municipal Gas Manufacturing Company was organized yesterday at the office of T. Moultrie Mordecai, the solicitor of the Company, the entire capital stock, $350,000, being represented.

The following officers were elected:—President, Adolph H. Lazare; Directors, Gustave Ranger, Cornelius Donkersley, Charles W. Kohlsaat, R. C. Gilchrist, H. H. Epping, George Manley, Daniel S. Silcox, J. L. Hobson, Adolph H. Lazare; Treasurer, F. Van Riper; Clerk, J. J. Legare; Engineer, Henry J. Davison; Solicitor, T. Moultrie Mordecai; Consulting Counsel, Foster and Thomlison.

The Company only awaits the favorable action of the City Council on the petitions of themselves and over three hundred large gas consumers and taxpayers, praying that permission to open the streets be granted, to enter into contracts for the manufacture of the necessary machinery and pipes, so as to have their works in operation early next year.

The method of production will be under the patents known as the "Tessie du Motay," now in successful operation in New York, Brooklyn, and elsewhere, furnishing, it is claimed, a gas of exceptional purity, a density of .480, and an illuminating power of from 20 to 30 candles.

PROCEEDINGS OF COUNCIL.

COUNCIL CHAMBER,
Special Meeting, July 29, 1880.

Council met this day. Present—Hon. William A. Courtenay, Mayor; Aldermen Dingle, Roddy, Aichel, Webb, White, Ufferhardt, Moran, Sweegan, Follin, Loeb, Eckel, Thayer, Johnson, Mauran, Feehan, Rose, Nell, Barkley, and Rodgers.

The Mayor stated that Maj. R. C. Gilchrist would resume his argument commenced last evening on behalf of the Municipal Gas Company.

Major Henry E. Young followed for the Charleston Gas Light Company.

Major G. Lamb Buist concluded the discussion on behalf of the Municipal Gas Company.

Alderman Thayer moved to defer final action until the next regular meeting of the Council, when the matter under consideration could be taken up under the regular order of business.

Alderman Sweegan offered the following resolution as an amendment:

Resolved, That after hearing able argument on the part of the proposed Municipal Gas Manufacturing Company and the now existing Charleston Gas Light Company, on the subject of manufacture, safety, etc., of different kinds of gas, and the necessity of competition, etc., this Council are of the opinion that the retention of the expensive roadbeds just completed on our principal streets in the present condition, and the necessity of resuming operations on other thoroughfares as soon as the time fixed by the city ordinance will permit, is of more importance than the creation of new gas companies, no matter by what process manufactured, and the petition of the proposed Municipal Gas Manufacturing Company, for permission to open the streets, lanes, alleys, etc., of the city, *be not granted*.

Alderman Rodgers moved to lay the resolution on the table.

The yeas and nays were called, and resulted as follows:

Yeas—Aldermen Dingle, White, Eckel, and Nell—4.

Nays—Aldermen Roddy, Aichel, Webb, Moran, Sweegan, Follin, Loeb, Thayer, Johnson, Mauran, Feehan, Rose, Barkley, and Rodgers—14.

The resolution to lay on the table was therefore lost.

Alderman Ufferhardt having been excused had retired from the meeting. The Mayor declined to vote.

After discussion Alderman Dingle offered the following resolution as a substitute for the resolution of Alderman Sweegan:

Resolved, That the petition of the Municipal Gas Manufacturing Company of the City of Charleston be granted, subject to the conditions, stipulations, and restrictions as set forth in their proposition made to City Council through their attorney.

Resolved, further, That the Corporation Counsel be instructed to prepare the necessary papers to carry out the terms of said proposition with said Company, and provide for satisfactory guarantees.

Alderman Barkley moved to lay this resolution on the table.

The yeas and nays being called for, resulted as follows:

Yeas—Aldermen Roddy, Aichel, Webb, Moran, Sweegan, Follin, Eckel, Johnson, Feehan, Rose, and Barkley—11.

Nays—Aldermen Dingle, White, Loeb, Thayer, Mauran, Nell, and Rodgers—7.

The resolution to lay on the table was therefore carried. The Mayor declined to vote.

The Mayor stated that he would have the roll called on Alderman Sweegan's resolution, and any Alderman who considered that the Eleventh Rule of Council applied to him could be excused from voting if he desired it.

The call of the yeas and nays resulted as follows:

Yeas—Aldermen Roddy, Aichel, Webb, Moran, Sweegan, Follin, Johnson, Feehan, Rose, and Barkley—10.

Nays—Aldermen White, Loeb, Eckel, Mauran, Nell, and Rodgers—6.

Aldermen Dingle and Thayer and the Mayor were excused from voting.

The resolution of Alderman Sweegan was therefore adopted.

On motion, Council then adjourned.

GLENN E. DAVIS,
Acting Clerk of Council.

THE COMPANY INTEND TO PERSEVERE IN THEIR EFFORTS.

26 BROAD STREET.
CHARLESTON, S. C., July 30, 1880.

To the Citizens of Charleston:—

I am instructed by our Board of Directors to state that notwithstanding the adverse action of your City Council last evening, in rejecting by a vote of ten to six our reasonable petition to open the streets the coming fall (under restrictions than which we venture to say none more liberal were ever granted to a city or its inhabitants), we do not propose to be deterred from our undertaking.

We know that we have the sympathy and support of the general public, excepting the stockholders and friends of the Charleston Gas Light Company. No pains will be spared in asserting our rights and privileges as American citizens till we have established our works and given to you, both rich and poor, the inestimable blessing of cheap light, fuel, and motive power.

Your obedient servant,
T. MOULTRIE MORDECAI,
Solicitor of the Municipal Gas Manufacturing Company of Charleston, S. C.

EFFECT ON STOCKS.

CHARLESTON, July 31.

The action of the City Council in refusing the Municipal (Water) Gas Company permission to establish their works in this city had a stiffening effect on the stock of the Charleston Gas Light Company. On Thursday the stock was offered freely at 19. Yesterday 20 was asked. There were no sales, however, at that price.

The attorneys of the Water Gas Company say that they have full authority from their principals in New York to push the matter, and they claim to be perfectly satisfied that their success is only a question of time.

Major Henry E. Young, in his argument before Council on Thursday night referred to the relative market values of the Manhattan (Coal) Gas Company and the Municipal (Water) Gas Company, as shown by the latest market reports. The quotations should have read: Manhattan, 190 to 192—par 50. Municipal, 175 to 180—par 100. The friends of the Municipal Company say that the reason for this decline in their stock since March last, when it was quoted at 216, is that there has recently been paid a large stock and cash dividend.

REMARKS BY MAJOR GILCHRIST BEFORE COUNCIL.

Major Gilchrist gave a brief history of the company he represented, showing that it was an incorporated body, and that $350,000 had been paid in as capital stock. He did not think Council had anything to do with the

effect of the establishment of the new company upon the stock of the old company. Private rights must always give way to public benefits. When the New York Municipal Gas Company was organized, he said, the stock of the Metropolitan Company was selling at $310, with a par value of $50; now it is quoted at $167, and the stock of the Municipal Company has gone up from par to $210. The fact that the stock of one company has gone up while the other has gone down is a full answer to all the objections made. In Poughkeepsie five years ago gas was worth $4 per 1000 feet. Under the new water process the whole city and the public is supplied at $1.75 per 1000 feet. A letter from the Poughkeepsie *Eagle* shows the remarkable economy of this new manufacture. In 1874, for three months from March first, this office consumed 41,500 feet of gas at a cost of $149.40 net, and in 1880, 30,500 feet at a cost of $57.25. All of the reports are favorable as to the quality and strength of the light produced. A letter was read by Major Gilchrist from Mr. W. H. Pearson, a coal gas expert of Toronto, showing that the water gas is cheaper than the coal gas, giving a higher illuminating power for less money, and that it will be manufactured in preference to the coal gas as long as the materials make it profitable to do so. In London the price of gas has been fixed by parliamentary enactment, so that the manufacturers can never make more than 10 per cent. on their investment, and gas is now selling at 72 cents in London, and the companies are paying a dividend of 10 per cent to the stockholders. It is so in Massachusets, the price being limited by law to not more than $2 per thousand feet. By these limitations the consumer is protected while the manufacturer is not injured. The Charleston Gas Company can charge as much as $4 per thousand feet, and in one year since the war it raised the price to $8.

Major Gilchrist said that carbonic oxide in water gas was valuable as a body gas the same as hydrogen, and that the holders of the patent would not eliminate it if they could. He further said that eminent scientists had given it as their opinion that it was not as poisonous as marsh gas, which is the body gas of coal gas.

The following notice appears in the Charleston papers:

NOTICE.—At the next session of the General Assembly of South Carolina an application will be made for a charter incorporating the Municipal Gas Company of South Carolina.

Verdict for the Yonkers Gas Company.

The suit of the Westchester Gas Company to recover for gas alleged to have been taken by the Yonkers Company was terminated on Tuesday by a verdict for the defendent. We will endeavor to summarize the chief points in the two weeks' trial.

It was agreed that the Yonkers and the Westchester were competing companies down to 1878—each company having a line of mains and consumers in the principal streets of Yonkers. In 1878 the two companies made a contract of settlement, dividing territory on the lines of North Broadway, Palisade avenue, and Elm street. This settlement contained two points of importance in the present controversy: First—That each company assigned to the other all its mains lying in the other company's districts. Second—That all the gas to be sold by the Westchester Company should be made at the Yonkers Company's works and delivered by meter to the Westchester Company through a special main running from the Yonkers works into the Westchester gasholder. And this settlement was followed by the appointment as Superintendent of the Westchester Company of Edward U. Slade, brother of James Slade, Superintendent of the Yonkers Company.

All things worked smoothly under this settlement until the Municipal Company began to build works in Yonkers, when the Westchester Company became alarmed, and endeavored to induce the Yonkers Company to use some water gas process, especially the Lowe process, as an efficient means of competing with the water gas of the Municipal Company. But it was found that the ownership of the Lowe process was in dispute, and subsequently the Yonkers Company put in another process, and began making a water gas in December, and continued to improve it until the beginning of April, when Superintendent James Slade had developed it into a new process, which is called the Slade process, and is still in use.

But the Westchester Company, professing to be dissatisfied with the progress made by the Yonkers Company, commenced in March to put in the Lowe works, and at the end of April, being ready to make the Lowe gas, cancelled the contract of settlement with the Yonkers Company, and the two companies again came in competition. On the cancellation of the contract the pipes which each company assigned to the other reverted to the original owners, and on the first of June the Westchester Company came over the line of division and resumed possession of its old mains in Main street, South Broadway, etc., and began to supply consumers through them in the Yonkers district. And on the 11th of June the Yonkers Company, following this example, also went into the Westchester district, by what is called "the midnight raid," and resumed possession of its old mains. This resumption, however, was hotly contested by the Westchester Company, and is now the subject of another suit in the supreme court.

In the suit just tried it was claimed by Mr. Van Pelt that the retaking by the Westchester Company of its old mains in Main street, etc., was brought about by the collusion of the two Slades—that the Yonkers Company, desiring a pretext to get possession of its old mains in the Westchester district, the Yonkers Slade told his brother, the Westchester Slade, that the Yonkers Company had no use for those old mains, and that the Westchester Company might take them; and the Westchester Slade reporting this to his superiors, was told to take them, and accordingly did so. But both the Slades swear that there is no truth in this statement. On the contrary, E. U. Slade, of the Westchester, testifies that his brother never offered them to him, and that the first person who spoke to him about taking these pipes was Mr. Van Pelt, who ordered him to do it, and that he remonstrated against the order because it would lead to the taking of its old pipes by the Yonkers Company, and he afterward said that this mismanagement of Mr. Van Pelt had almost ruined the Westchester Company. Judge Ellis on this point charged, as matter of law, that the cancellation of the contract by the Westchester Company restored the mains to the original owner, so that the Yonkers Company had a perfect right, after the 1st of June, 1880, to go into the Westchester district and take possession, as it did, of its old mains.

It was alleged by Mr. Van Pelt that immediately on receiving the thirty days' notice of the cancellation of the contract, the Yonkers Company shut off the supply of gas to the Westchester Company, intending to leave the Westchester district in darkness. All the witnesses who were examined on the subject testified that the Yonkers Company did not shut off the gas at all, but that it was shut off by the Westchester Company, and that the Westchester Company was at liberty to have taken gas at any time during the thirty days.

When it was found that charges of collusion and fraud were made against all the officers of the Yonkers Company, the defence called in two experts, whose testimony might be above suspicion. The first expert was E. S. Cathels, a well-known gas engineer, member of the Institute of Civil Engineers of England, of the British Association of Gas Managers, and of the American Gas Light Association, and a practical manager of gas works for many years, and having been engineer of the Montreal Gas Works for several years. The second expert was Capt. William Henry White, Secretary of the Gas Light Association of the United States, and a gas engineer of long experience, having been engineer in practical charge of gas works for fifteen years.

It was then shown that the Westchester Company during May, 1880, made 460,000 feet of gas, and in June 494,000 feet, making a total of 954,000 feet; and that it sold to consumers and to public lamps 268,900 feet in May, and 215,700 feet in June, making a total sold of 484,600 feet, and that the difference, 469,400 feet, was loss; and it was argued that the Yonkers Company must have purloined it, and was now purloining it.

In reply the quantity of gas made was disputed. It was shown that the Westchester Company has no meter to measure the gas it makes, and consequently cannot know. The experts were very positive on this point. An attempt to measure gas by the rise and fall of the holders is vitiated by the fact that gas is going out and in at the same time, and also by the fact that change of temperature changes the bulk of the gas. A holder might appear to have five thousand feet more in it when the sun is shining on it than it had in the morning, while not a foot of gas had gone in it. And if the company has no means of knowing with certainty how much gas it makes, it cannot know how much it loses. It was also shown that the average loss of the Westchester Company heretofore, due to imperfect pipes, had been 30 per cent. of its make, and now that it has taken on these old mains in Main street and South Broadway, so great were the leaks that complaint was made to the Yonkers Company by its own consumers, and several leaks were found on the Westchester mains, a single one of which was one inch and a quarter in diameter, and Mr. Cathels testified that such a hole would waste two thousand feet per hour in the open air, and when buried in the ground, as this was, would probably waste more than twelve thousand feet per day. He thought the whole loss complained of was easily explained by the imperfect pipes.

As a reason for the alleged purloining it was claimed that the gas of the Yonkers Company in April was smoky, and although Prof. Love certifies to thirty candle power, so many complaints were made of smoke and smells, the Westchester Company claims, that the Yonkers Company attempted to find a remedy by surreptitiously taking its Lowe gas to mix with it, and that it thus improved toward the middle of May till it became a good gas. To this it was replied that the Yonkers gas was always good in suitable burners; that many of its consumers said they never saw such good gas as they had in April, and that when it smoked it was from unsuitable burners; that the Municipal Company, and all companies supplying a rich gas,

always put on new burners when they get a consumer, and that the Yonkers Company at the end of April began putting on new burners, and as soon as the burners were suitable the gas was all right. It was also shown that in April the Yonkers Company was running with too high a pressure for so rich a gas, thus causing smoke—and the pressure was gradually reduced till near the middle of May, when it was brought to the pressure at which it still continues. The experts testified that the Yonkers Company was making a brilliant water gas, that no mixture of Lowe gas could improve it, and that if it smoked it was because the burners were unsuitable, or the gas was too rich, and the rich gas could be better reduced by turning on a little more superheated steam—increasing the water gas—than by introducing the Lowe gas.

It was charged that by collusion between the Slades, while Edward was superintendent of the Westchester Works, the special main by which the Yonkers gas had been carried to the Westchester works was now used to bring the gas back to the Yonkers holder. This was soon shown by all the witnesses, including the experts, to be a physical impossibility. For gas is forced through the mains by the dead weight of the holders containing the gas and floating with it on the water in the tank, and that the Yonkers holders were so much heavier than the Westchester holder that if the pipe between was open the gas would inevitably flow into the Westchester holder, instead of the Yonkers holders. And besides, gas flows up hill as naturally as water runs down hill, and the Westchester holder being considerably more than a hundred feet higher than the Yonkers holder, it would naturally get all the gas. This proof was so strong that this claim was practically abandoned. But it was then claimed that some mechanical contrivances might have been introduced in the Yonders works to bring the gas down from the Westchester holder and force it into the Yonders holder. To this it was replied that some mechanical appliance could of course be used, in fact was used by all gas works, to force the gas under the holder. A steam injector would do this, but no gas company ever had a steam injector or anything else to pump gas back out of the main into the holder—that no such thing existed at the Yonkers works, and that if it should be attempted it would draw all the gas out of the mains and fill them with air.

Long series of tests made on the 4th and 5th of July by pressure gauges were produced by plaintiff, the substance of which was that a change of pressure of two inches at the Westchester works was followed in from three to ten minutes by a change of three-tenths of an inch on the gauge in a house on the Yonkers main. This, it was argued, indicated some small connection between the two systems of street mains. James Slade discovered this disturbance on the 2d of July, and attributed it to an accidental connection of service pipes, and made diligent but unsuccessful efforts to find it, and also asked the co-operation of the Westchester Company in the search, but the Westchester Company would do nothing. One of the plaintiff's witnesses said that a three-quarter inch pipe making the connection would account for all the changes shown. The two experts thought even a smaller—an accidental connection on some service pipe—would account for it. And they were very decided in their opinion that if such connection existed, with the relative position of the Yonkers and Westchester holders, the gas would flow into the Westchester mains, and not into the Yonkers mains.

Judge Ellis's charge occupied about three-quarter of an hour, and was so fair that both parties thanked him for it. The jury had manifested throughout the closest attention to the evidence and the arguments, and after a careful deliberation of about two hours brought in a verdict for the defendant.

Mr. Van Pelt, for the plaintiff, asked a stay of proceedings for thirty days to prepare papers for an appeal, and the application was granted.—*Yonkers Statesman*, Aug. 12.

Lighting of Public Libraries.

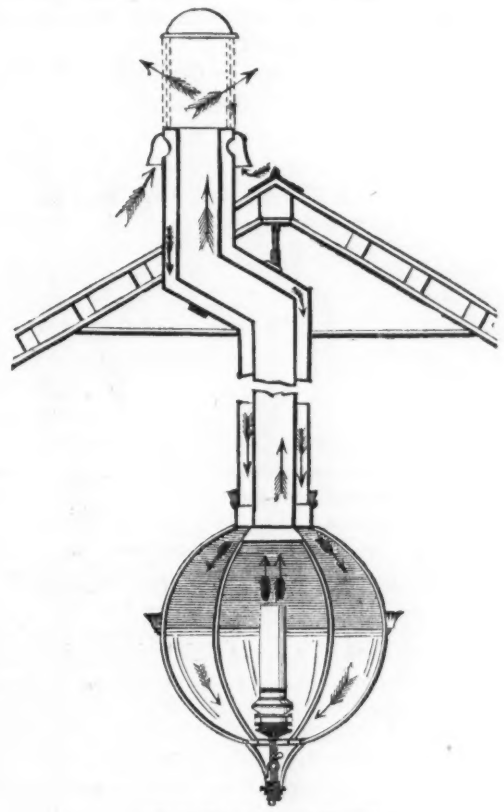
A great deal is said, first and last, about the injurious effects on the binding of books caused by the sulphuric acid produced in the combustion of illuminating gas. Most of the larger libraries are closed at sundown for the want of some means of illumination which shall be sufficient and suitable for the reader, and at the same time free from anything likely to injure the books.

While we do not question the statement that the sulphuric acid produced in burning gas injures book bindings, and while there is abundant proof to show that this acid is found in the binding of old books exposed for long periods of time to the products of the combustion of gas, we know of no instance in which it has been proved that the acid in the book binding came from the burning gas. When we consider the fact that the quantity of sulphuric acid found in the binding of an old book is very small, and also that the binding of many new books shows the presence of this acid, either as a result of the tanning of the leather or in some material used in binding, we see that there is considerable room for speculation.

It is not our object to discuss the question of sulphuric acid in book binding, but to endeavor to correct the very popular impression that gas cannot be used with perfect safety in large libraries. Most public libraries are built with an express object in view, and there would be no difficulty in arranging the artificial illumination so that the products of the combustion of gas could be carried off and never come in contact with the books. To arrange sufficient light for a building never built for library purposes, and do it economically, may be more difficult; but in any case it can be done.

The accompanying illustration from the London *Journal of Gas Lighting* shows a light devised by Mr. Sugg, and similar to some in use at Eton College.

The cut tells its own story. It is of globe form, the lower half of clear glass and the upper of white glass. A large argand burner is used, giving a light of from 100 to 200 candles. A flue extending from the top of the



Self-Ventilating Light.

light is composed of an inner and an outer chamber, the former to carry off the products of combustion, and the latter to furnish fresh air to the burner. In this way it is made entirely independent of the atmosphere of the room. Mr. Sugg says this lamp will not raise the temperature of the room 1°. The outer chamber can be dispensed with and the air supply taken from the room through openings in the bottom of the lamp. It thus possesses the additional advantage of aiding in the ventillation of the room. *Sanitary Engineer.*

A Theory of the Western Tornadoes.

Prof. Tice expresses the opinion that all such whirlwinds as occasionally sweep the Western States are electrical storms, not wind storms. There was, he says, no wind attending the Marshfield tornado. Among the evidence of the electrical nature of that storm he notes the fact that it destroyed every building which had a tin roof, or which had any metal of any kind in its roof. In Marshfield it passed directly over several buildings with shingle roofs, and tore to fragments others, not more exposed, which had metal roofs.

A mill, situated over a quarter of a mile away from the centre of the cyclone had its iron chimney torn out and carried a long distance, while the mill itself suffered very little damage. The cupola of the public school building at Marshfield, which had a tin roof, was wrecked, but the building, which was roofed with shingles, was not injured to any extent.

Even more conclusive and remarkable, he thinks, were the phenomena manifested in connection with trees and shrubbery. The bark was stripped from the trees and bushes not alone on those sides exposed to the force of the cyclone, but on all sides. The ends of the branches were not only denuded of their leaves and bark, but were rifted into fine fibers, so that they

presented the appearance of little brooms. The active agent in such cases, he insists, was not wind, but electricity. Under its influence the sap under the bark was instantly converted into vapor or gas, expanding 2000 times in volume, and, as by an explosion, threw off the bark, shattered the trunk, and split the green twigs into fibers. That this is what took place is, he says, conclusively proven "by the fact that the dead and dry limbs and twigs were not affected, and though in immediate contact with green ones, remained intact.—*Iron Age.*

[From London "Journal of Gas Lighting."]

The Recent Gas Explosion in London.

The following report on the recent gas explosion near Tottenham Court Road, by the Engineer (Sir J. W. Bazalgette) and the Consulting Chemist (Mr. T. W. Keates) of the Metropolitan Board of Works, was presented at the meeting of the Board on Friday last, and a copy ordered to be forwarded to each of the London gas companies:

SPRING GARDENS, S. W., July 23, 1880.

To the Works and General Purposes Committee:—

In compliance with the order of the Board we beg leave to submit the following report upon the circumstances attendant upon the gas explosion which occurred in a large gas main belonging to the Gas Light and Coke Company, on the 5th inst.

It is probable that the members of the Committee have made themselves generally acquainted with the circumstances of this occurrence; but it is necessary, in order to make our report clear, that we should trouble the Committee with some details, which are perhaps already known to them, but which cannot conveniently be omitted.

The main in which the explosion took place extended from the corner of Bayley Street, Tottenham Court Road, along Percy Street, and up Charlotte Street, where it was united to an equally large main running along Howland Street, but being cut off from the Howland Street main by a valve which appears never to have been opened up to the time of the explosion. These mains were of large size—3 feet in diameter.

The portion of the main along which the explosion occurred commenced with a plugged (or closed) end in Bayley Street opposite the Bedford Head Hotel; it then crossed the Tottenham Court Road, ran along Percy Street, and thence north along Charlotte Street, to the valve in Howland Street.

This was a new main, which was intended to be continued eastward. It appears to have been completed and kept closed, or dead, for about two months, the connection with the eastern section in Bayley Street not having been made. Preliminary to the making of this connection, the main appears to have been tested in the usual way, a ½-half inch stand pipe having been let into the top of the main, so that a pressure gauge might be attached to it.

It was intended that the connection should be made on Tuesday, July 6. With this view, between 6 and 7 o'clock on the evening of Monday, the 5th, the plug or iron flange which stopped the Bayley Street end of the main was being cut out. The foreman was standing on the main at the time, and had removed the pressure gauge from the end of the ½-inch stand pipe. It is very important to remark that the gauge, before it was removed, had stood at zero, showing that there was no pressure in the closed main. The foreman had roughly tested the air in the main by smelling at the open end of the small stand pipe, and, "as an additional precaution," he put a lighted match to the orifice, which act was followed immediately by an explosion. Six other explosions followed upon this, in the course of the new main, but in one respect this was the most serious, inasmuch as it was by the effect of the first explosion that two workmen were killed.

The ground was open at this point, as it was here that the connection was to have been made between the two sections of new main. The two men who were killed were at work in the trench between the plugged end of the completed main and the open end of the unfinished portion. By the force of the explosion the iron plug was blown out with great violence, killing one man on the spot, and fatally injuring the other.

The explosion at the corner of Bayley Street was the first of the seven which ultimately occurred between this point and the valve at Howland Street.

Taking the distances of the exploded portions of the main in order from Bayley Street, the second explosion took place in Percy Street, about 215 feet from the first. At this point about 110 feet of the main, and the paved carriage-way for a width of from 10 to 12 feet, was blown up, and the footway, area walls, and various parts of the houses Nos. 14 to 19 Percy Street, were damaged.

The third explosion was about 465 feet from the first, and was opposite No. 6 Percy Street; 12 feet of the main and 20 feet by 15 feet of the carriage-way were blown up at this point; the footway and the houses Nos. 5 and 6 were damaged; some damage also was done to Nos. 7, 8, and 9, on the same side of the street, and to Nos. 32 and 35 on the opposite side of the street.

The fourth explosion was 645 feet from the first, and was opposite Nos. 3 and 5 Charlotte Street. At this place 11 or 12 feet of the main were blown up, and the road, footway, vaults, and areas were destroyed within a space of 28 feet by 24 feet, besides other damage which was done to the houses.

The fifth explosion was 955 feet from the corner of Bayley Street, and was opposite to Nos. 29 and 31 Charlotte Street, at the corner of Bennett Street. An opening was made in the street at this place, the opening being 55 feet long, 10 feet wide in one part, and 23 feet wide for the remainder of the distance; the vaults being destroyed and a good deal of other damage done to the property.

The sixth explosion was 1835 feet from the point where the first occurred; this was opposite 103 and 104 Charlotte Street. Here 12 feet of main were blown up, and an opening 28 feet by 31 feet was made in the carriage-way; the two houses were also damaged. The local sewer also appears to have been seriously injured.

The last or seventh explosion took place at the right-angled junction of the two 3-feet mains at the point where Howland Street crosses Charlotte Street and Fitzroy Street, or about 2075 feet from the corner of Bayley Street, where the first explosion took place. The valve which at this junction cut off the charged main in Howland Street from the closed or dead main in Charlotte Street, and also the T-piece junction, were shattered to pieces, and an opening 12 feet by 10 feet made in the carriage-way; but there appears to have been no further damage in this locality.

With regard to the first point, two theories were raised to account for the presence of sufficient gas in the new main to produce the explosive mixture of air and gas. One of these supposed the gas to have entered the main by leakage from without; the other that the gas entered at the Howland Street end of the new main in consequence of a defect in the valve, which was situated at that point.

There seems very little probability that the gas could have entered the new main by leakage from without, and no reason seems to have been given to support that view. In our opinion there can be very little doubt that the gas found its way into the new main through the valve at Howland Street, which might by some means have been slightly injured. In that case a leakage of no great amount would be sufficient to admit enough gas to account for the mischief. The cubical contents of the whole main involved in the explosion were between 14,000 and 15,000 feet, and as it is obvious, from the circumstance that explosions occurred only in certain points in the course of the main, that the whole of the contents were not explosive, probably less than 2000 cubic feet of gas were in the main in more or less complete admixture with the air, and it would not require a great leak in the valve for 2000 feet of gas to pass in the course of the time during which the new main had remained unused after its completion.

The coroner's jury took the view that the gas had entered the new main in consequence of some defect in the valve at the Howland Street junction, and this appears to us to be the correct view. Unfortunately the valve and its fittings were entirely destroyed by the last explosion, so that there were no means of making any investigation concerning the previous state of the valve; but all the circumstances of the case seem to point to the valve as the origin of the mischief, whereas there seems to be nothing to support the theory that gas found its way into the new main by leakage inwards, such gas having previously leaked out of other mains in the vicinity of the new main.

If it be admitted, as is most probable, that the gas passed by the valve from the fully charged main in Howland Street, into the new main in Charlotte Street, the formation of an explosive or inflammable mixture of gas and air was a necessary concomitant; whether such mixture would be explosive or merely inflammable was only a question of proportion between the gas and air, and the completeness of the admixture or diffusion of the gas. If the gas were in less proportion than about 7 per cent. by volume, or more than 25 per cent., it would burn away quietly, and not explode; but if it were in the proportion of something between 7 and 25 per cent., the mixture would be more or less violently explosive. It seems certain that a mixture of gas and air, explosive in some places but only inflammable in the great part of its course, had been formed in the new gas main, and further it seems only reasonable to believe that the gas had entered by the valve, and not by leakage inwards, into the main, which had been proved to be thoroughly sound under considerable pressure of air, which had been kept on from Thursday, the 1st, until Sunday, the 4th of July.

With respect to the second point for consideration, it is very interesting to observe that a number of distinct explosions took place in regular order, and with a clear interval of time between them. It seems, at the first view of the matter, remarkable that this should have been the case, as it might

have been expected that the gas would have diffused itself into the air contained in the main during the considerable time that had elapsed after the main was finished up to the plugged end, and that a uniform mixture would have been formed, either simply inflammable or explosive in its nature. If the mixture were explosive, then it might have been expected that one general explosion of the whole of the contents of the main would have taken place at one moment, the iron pipe probably giving way in any spot in which it was weakest, or in which the pressure of the earth above and about it happened to be least. This, however, was not the case. When the light was applied to the top of the stand pipe at the end of the main at Bayley Street an immediate explosion followed, the effect of which extended only to that particular spot; after an appreciable time had elapsed a second explosion occurred in the course of the pipe; then another, and so on up to seven; the distance between the points of explosion varying from 180 to 880 feet. With the exception of the fourth explosion, at the corner of Charlotte Street and Percy Street, the points of disruption were in the straight run of pipe, and the effect was exactly as if a mine of gunpowder had been laid at each point where the explosion occurred; if such mines had been connected by a match, they would have exploded in succession, as the match burned away, exactly as the gaseous mixture exploded in the main.

It is not easy to understand why the mixture of gas and air should have been formed in such different proportions in different parts of the pipe that in some places the mixture should be explosive, in other places only inflammable. It has been suggested that the mixture was uniformly explosive throughout the whole length of the main, but that the disruption or bursting of the main only occurred in certain comparatively weak places. This view does not, however, bear examination. If the mixture of gas and air had been uniformly explosive, it can only be believed that the explosion would have been momentary from one end of the pipe to the other, and that the bursting of the pipe at the seven different points would have been almost or quite simultaneous. This, however was not the case. Testimony shows that the seven explosions followed each other with a distinct interval of time between them, just as would be the case if an explosive mixture of gas and air had existed at the seven points of disruption, and a simply inflammable mixture along the pipe between those points, such inflammable mixture only serving as a means of carrying the fire from one collection of explosive mixture to the other, and the time which elapsed between the explosions being consumed in the progress of the flame along the pipe. Flame does not travel with very great rapidity under such circumstances, and the intervals between the explosions would be thus fully accounted for.

It seems impossible to doubt that, from some cause or another, mixtures of air and gas in different proportions did really exist in the main at the time of the catastrophe; that at certain points, where indeed disruption took place, collections of an explosive mixture had formed, while between those points the mixture was only inflammable. It is difficult to explain why this should have happened, but it seems impossible to account for the occurrence of the seven successive explosions upon any other hypothesis. It might have been that irregular diffusion of the gas was favored by some irregularity in the vertical position of the main; but any attempt to account satisfactorily for the conditions which led to the remarkable circumstances of the occurrence must, with our limited knowledge of the facts, be merely speculative.

After all, the most important question now as to the practical lesson to be learned from this accident. It is obvious that considerable danger may exist in connection with the practice of testing gas mains before they are brought finally into use, and that when the mains are of the large size now generally laid down, and where the cubical contents are consequently great, the danger may be very considerable, as has been shown in the case now under consideration.

In the first place, the application of a light to test the unknown contents of a main which is in connection with another main charged with gas, is an act which seems to us to border on temerity. It is quite impossible to know that leakage from a charged main into a new main may not take place at any time. Under such circumstances the formation of an explosive mixture is only a question of degree. and to suppose that fire will not travel down a pipe, even of small diameter, is a very dangerous error.

In the second place, the danger of applying a light might be entirely avoided. The Davy lamp affords an illustration that flame may be applied to test a gaseous mixture, provided that proper arrangements be made to prevent the direct contact of the flame with the inflammable or explosive mass. If on the top of the stand pipe screwed into the main at the blank end in Bayley Street there had been applied a contrivance analogous in principle to that of the Davy lamp, or like what was known as Maugharm's jet in connection with the oxy-hydrogen blowpipe, no danger in applying a light would have existed, and no accident would have occurred. It is desirable that the attention of gas companies should be directed to this point. To apply a naked light to the top of a stand pipe connected with a main in the manner in question was a most dangerous act, and such a thing ought never to be repeated without precautions quite easy of application, and would be effective in obviating danger.

(Signed) J. W. Bazalgette, Engineer.
T. W. Keates, Consulting Chemist, ect.

Of the seven persons who were so severely injured on the occasion of the explosion as to necessitate their becoming in-patients at the Middlesex Hospital, only two at present remain there under treatment. These are Emma Byrant, the servant at No. 3 Charlotte Street, whose recovery was for some time extremely doubtful, and George Trite, the nephew of the landlady of that house, who was very seriously injured. One man, who received a severe scalp wound, has become an out-patient of the Hospital, and another, who was similarly injured, has been discharged. No other deaths beyond the two recorded at the time of the accident have therefore taken place. An appeal on behalf of the sufferers was publicly made shortly after the accident, by the Chaplain of the Hospital, and it has been well responded to, the total amount already received being £81 3s. He now announces that, in consequence of the liberal arrangements that are being made for the sufferersby the gas company, further contributions will not be needed.

In the meantime, the work of restoring the broken main, and shoring up and reinstating the house property and roadway damaged by the explosion, is being prosecuted with great diligence. The trench at the corner of Bayley Street has been filled in and the thoroughfare repaved, while in Percy Street, where probably the greatest damage was done, the pavement on the south side has been again opened for pedestrians and business resumed. There still remains much to be done in the way of rebuilding and making good the basements of the damaged houses, but the work is steadily progressing, and it is probable that in a very short time comparatively few signs will exist of the havoc caused by this remarkable catastrophe.

The Drainage Question at our Seaside Resorts.

We do not anticipate that serious attempts at the purification and utilization of sewage can ever be successfully made on a large scale for the treatment of drainage of great cities; and so far as we can learn of the introduction of such systems as practiced in Europe, their operations are conducted on a comparatively limited scale. For the present we may be thankful if we can effectually rid ourselves of our offal; and while we may regret the fact that we are annually pouring millions of dollars worth of rich fertilizing elements into the convenient river that receives our drainage, for the present at least it cannot be helped.

We are, however, specially interested, in this article, with the manner in which the question of drainage is treated at our popular health resorts. Some of these places, especially the seaside resorts, which are visited during the summer season by hundreds of thousands of health and pleasure seekers, have absolutely no provision for the disposal of their sewage. The offal of these multitudes, year after year, is simply allowed to filter into the sand, or, where special provisions are made to receive it, they are of the crudest and most inefficient description.

In the few cases where sewer pipes are employed, the solid refuse emptied into a convenient inlet or bay, is often swept upon the beach by the next tide. At other places these troubles are aggravated by the dumping of the garbage of adjacent cities so close to their confines that the surf and beach are disgustingly defiled by it. Happily, the luxury of a bath with such floating accompaniments as decayed vegetables and what were once cats, and other things equally unsightly and unsavory, can only be offered by a few of the seaside resorts in the neighborhood of this city. But, annoying and disgusting as this is, it is an open question, in the presence of the serious dangers from defective drainage, or none at all, whether it really adds to the unwholesomeness of a soil already saturated with filth about the hugh hotels and caravansaries.

To come to the point, the foul condition of very many of these places has become so notorious that many who were formerly their patrons now avoid them—physicians send their patients elsewhere, and unless measures are speedily taken to improve their sanitary condition in respect to drainage, it is only a question of time when they will become disease-breeding instead of health-giving resorts.

Of this state of things it is pleasant to be able to note some exceptions; and at one of the best known seaside resorts in the neighborhood of New York (Brighton Beach) the managers have had the rare good sense to introduce an admirable system of disposing of their sewage, which we should be pleased to see very generally introduced. The plan, as described in the newspapers of the day, consists in substance in receiving all the sewage into reservoirs, in which the solids are separated from the liquid portion by simple mechanical means. The liquid portion is then purified by chemical

treatment. by which its organic matter is precipitated, and the purified liquid allowed to flow away into a neighboring creek. The solid matter is likewise subjected to a simple chemical treatment, and thereby converted into a valuable fertilizer.

We mention this one circumstance to show what can be done to remedy the crying evils of defective drainage at most of our seaside resorts, if only the effort to do so is intelligently made. The only questions are, whether the authorities of these places will take the initiative and do it of their own accord, or whether they will wait until an outbreak of infectious disease forces them to do it.—*Manufacturer and Builder.*

Progress of the Electric Light Abroad.

The fact that much more publicity is given in England and on the Continent than here to the results attained by the promoters of the electric light has given rise to the erroneous idea that little is being done here. Such is not the case, however. The applications of the light to the illumination, not alone of large spaces and of places of amusement, but also of factories and mills, are becoming more numerous. It is even rumored that Edison, of whom the public has lost sight entirely, has nearly completed works to test his light on a large scale in this city. The development in this country is steady and encouraging, because it is divested of all attempts to catch public attention by sensational reports.

Abroad inventors are active and capitalists confident. The *Times* summarizes progress there in an able manner, but falls into the error of underrating the strength of the movement here. M. Gramme, who has done so much to aid the progress of electric lighting, is adapting his well-known dynamo-electric machines to the requirements of the Jablochkoff, the Werdermann, the Rapieff, and other forms of the light. M. Jamin has come forward with a new light, and the Siemens light is said to be more than maintaining its reputation. The Brush light has been introduced into England from this country, and its use is extending. The Jamin light consists of three candles placed side by side, each candle being formed by two parallel carbon pencils held in a vertical position, so as to burn from the bottom. A bank of fine copper wire surrounds the candle and conducts the electric current, and is so arranged that the luminous arc is always kept at the lower end of the pencils. When one candle is burned out the next is kindled automatically. Each candle burns two hours, and the cost of the carbon consumed is but a trifle over a cent an hour. A single lamp would thus burn six hours without requirtng any attention, at an expense of not more than 7 cents for material consumed, to which, of course, must be added the cost of generating the current. A Gramme machine, driven by an 8-horse engine at the rate of 1500 revolutions per minute, sustained twelve Jamin lights, each equal to thirty-two candles. It was found that with a machine making 1500 revolutions per minute, and a wire 1-26th of an inch in diameter, six lights could be sustained on a circuit of five-eighths of a mile. By doubling the size of the wire and increasing the revolutions to 2000 per minute, a circuit of ten miles can be operated. This light is in the hands of a French company with a capital of 8,000,000 francs, and one of its founders and directors is a man who is proprietor of about sixty gas works.

The most conspicuous success thus far has been won by the Jablochkoff system. For eighteen months the Societe Generale d'Electricite, in contract with the Metropolitan Board of Works, have maintained the light on the Thames Embankment without missing a single night. The light was recently suspended for a few days for the purpose of cleaning the engines, but has been resumed. It was found that a single 20-horse power engine under the Charing Cross bridge could maintain as many as 80 lights between Blackfriars and Westminster, something over 2½ miles. The number of lights in actual use, however, is but 50, extending the whole length of the Victoria Embankment.

Experiments undertaken with a view to reducing the expense of this light have been attended with very gratifying results. The terms of the contract for the next twelve months are at the rate of 5 cents per hour for each light, and the illuminating power of each is equal to 378 sperm candles, but this is reduced by the ground glass globes to 265. The lights burn six hours, but can be burned eight.

The Jablochkoff light has been successfully used for long distances, and on a large scale, the Paris Salon having been lighted by it with 400 lights for two months. A Russian company has been formed, with a capital of $4,000,000, to perfect and apply this system.

A steam engine is being erected in the South Kensington Museum for use in connection with the Brush light. A large court, formerly lighted by 1700 gas jets, is now lighted by eight Brush lamps, at a cost of but 3s. per hour, a saving of 10s. per hour as compared with gas at the London price of 80 cents per thousand feet. Here, as well as at the British Museum, the great advantage of the electric light over gas consists in the fact that it is perfectly harmless and void of danger, while the combustion of gas is destructive to paintings, decorative work, and book bindings. In a large biscuit factory at Bermondsey the light is found to possess the peculiar advantantage of enabling the workmen to distinguish the most delicate shades of color, a matter of necessity in that business. Bass's brewery is to have the Brush light, and the company are about to erect works in the heart of London, intending to supply the light from a central point over a circuit 10 miles wide.

The Siemens light has been permanently adopted at the British Museum, and is in use on a large scale at the Victoria Docks. The improvements recently made in the Gramme machine have increased the power of the Werdermann light, and its capability of subdivision—in which respect it is said to surpass all other lights—has led to its application to domestic uses on a considerable scale in Paris. The supply of electricity is generated at a central point, and the light is laid on by wires wherever required with as much ease as gas. A Werdermann light equal to 300 candles requires the use of only one-half horse power, and a 12-horse power engine will maintain 30 lights, each equal to 300 candles. A notable feature in the progress made by all these lights is in the reduction of operating expenses.

In conclusion, we may add that for European gas companies the electric light is losing much of its terrors, not because of a conviction that its competition need not be feared, but because gas manufacturers are becoming confident that there is ample room both for the electric light and for gas. M. Jamin has made efforts to convince a number of representatives of the gas interest at Paris of the absence of any danger to its future growth and prosperity. From the language of one of their number, M. Jordan, it appears that they are beginning to take this view.—*Iron Age.*

Lighting Rooms.

M. Javal, in a paper on public and private lighting, considered from the aspect of ocular hygiene ("Revue Scientifique," Oct. 18, 1879, p. 361), treats of artificial lighting. He says that a chandelier, carrying a million of wax lights, would not give an amount of light equal to sunlight. Even in a room, lit up in an unusually brilliant manner, the pupils are much more dilated than in full daylight; and this dilation explains the fatigue to the eyes produced by artificial light. Therefore there is never too much, in fact never enough, artificial light, and prejudices, without any just foundation, are prevalent on this point.

M. Javal recommends to persons suffering from certain optic defects, and who cannot work in the evening, two large lamps, which would obviate the fatigue of reading. Artificial light, also, excepting the electric and magnesium lights, contain much fewer chemical rays than daylight. All artificial spectra are very dull on the most refracted side; the chemical rays, the violets, and the blues there show a very low intensity.

M. Bouchardat ("Revue Scientific," Aug. 16, 1879, p. 148) has shown the dangers of violet and deep violet rays, on the authority of M. Regnauld's important work on the fluorescence of the media of the eye. The conclusion to be derived is that the flame light being much poorer in chemical rays than sunlight, should be preferred by workers. In fact, M. Javal quotes the instance of a member of the Institute whose fatigued vision would scarcely tolerate daylight, and who shut his shutter and lighted his lamp in order to work. M. Javal recommended him rather to work in daylight, with yellow spectacles to destroy the chemical rays.

Artificial light, on the other hand, considerably dilates the pupil, and renders the chromatism of the eye more sensitive, which is the reason that the light of day is preferred. The electric light is injurious in a certain point of view; a contains a large quantity of chemical rays, which it would be easy to neutralize by giving a yellow tint to the globes. Nevertheless, neither the public nor the experts have complained, up to the present time, of the electric light; inconveniences only arise when the eyes are fixed for too long a time on a too powerful electric light. It is therefore advisable not to look too long at electric lights, and when this becomes a habit, the opacity of the globes now in use can be diminished.

In fine, all our systems of artificial light are insufficient; there is, then, no necessity to fear excess of light, since, on the contrary, artificial light is less penetrating than daylight. Gas, therefore, does not destroy the eyesight, it is the wavering and flickering of the flame, when there is neither globe nor chimney, which fatigues the sight; gas light, with a burner protected by a globe, is excellent for it. M. Javal may well say, then, with dying Gothe—"Light, more light!"—*Sanitary Record.*

THE SENSIBILITY OF THE EYE TO DIFFERENCES OF LIGHT.—A. Charpentier.—The eye appreciates much better the differences of intensity of two contiguous lights than the differences of two successive lights, since in the latter case the differential sensation is seven to eight times stronger than in the former, in which it is not more than 1-100th part. The sensibility of the eye is constant for the whole extent of the retina.—*Chem. News.*

[From the London "Journal of Gas Lighting."]

Explosive Mixtures of Coal Gas and Air.

By Mr. W. Foster, M.A., etc.
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The disastrous events which have recently occurred through the ignition of explosive mixtures of coal gas and air have excited a considerable amount of attention, and have given rise to much unnecessary anxiety. As an abstract proposition, the dangerous nature of a mixture of coal gas and air is generally understood not only by those engaged in the manufacture and distribution of gas, but by a large section of the educated public. The best practical method of dealing with such mixtures and of preventing their formation is, however, a matter on which much misconception exists; and this chiefly arises from an insufficient appreciation of the general properties of gaseous bodies. A knowledge of the practical bearing of the laws of diffusion of gases is not by any means so general as one could wish. The present therefore appears a fitting occasion for a few observations on a subject of the greatest importance to all concerned in the manufacture and use of coal gas. It may appear an idle statement to say that coal gas, in a confined vessel, is perfectly harmless; but unfortunately one is continually meeting with persons in all grades of society who do not share such a simple opinion. It therefore often becomes a part of the gas manager's duty to instruct his customers with reference to the properties of the article which he manufactures.

Coal gas, whether cannel or common, is a mixture of several gases with the vapors of hydrocarbons of low boiling point. By far the greater portion of any given volume of common gas consists of hydrogen and marsh gas (CH_4), the sum total of these two component varying from 80 to 90 per cent. of the whole. In 1851, Dr. Frankland made an analysis of the common gas supplied by the Chartered Gas Company in London, and in 1876 the same company's common gas was analyzed by Mr. Humpidge. The results of these two analysis, so far as the chief components are concerned, are given in the following table—

	1851	1876
Hydrogen	51.8	50.5
Marsh gas (CH_4)	35.2	38.3
Carbonic oxide (CO)	8.9	3.1
Heavy hydrocarbons expressed in their equivalents of olefiant gas (C_2H_4)	7.7	7.8

Now each of these components when allowed to escape from a containing vessel into the external atmosphere can be ignited and consumed like any other combustible material. The oxygen of the air is necessary to carry on the chemical action which is commenced by the application of the ignited substance; and, in the case of the gases containing carbon, further provision is necessary for the removal of the carbonic acid gas produced. The high temperature required to start the combustion of the gas is maintained by the chemical combination of the latter with oxygen. Coal gas does not differ in these points from its individual components. For its ignition the heated body must have a temperature of a certain quality—a circumstance quite apart from the total amount of heat which it may possess. The smallest spark of brightly incandescent matter, whether solid or gaseous, is sufficient to inflame a jet of coal gas escaping in atmospheric air. An excellent illustration of this phenomenon is afforded by the use of the electric spark. If a person insulate himself from the earth by standing on a stool having glass legs, or on a couple of glazed earthenware jars, and whilst in this condition place his hand on the conductor of an electrical machine, sparks may be taken from his body during the time the machine is put in motion by a second individual. If a jet of coal gas be allowed to escape from a metallic burner within his reach, on his extending his other hand, and causing one of his fingers to approach the burner from above, a spark will at length pass to the burner, producing ignition of the gas. [It will be remembered that this principle was advocated on a limited scale a few years ago when there was a prospect of a tax being imposed on lucifer matches. The apparatus was ingenious but cumbrous.]

In this experiment the particles of gas in the track of the spark are rendered brightly incandescent; and although their mass must be extremely small, yet they are capable of setting up a similar condition throughout the whole gas jet. On the other hand, comparatively large masses of solids at lower temperatures are incapable of setting up a similar condition of things. For instance, a coal cinder at a dull red heat, and devoid of flame, will not cause ignition of a jet of coal gas, nor will the dull red embers of a recently extinguished deal wood match. It is clearly obvious, therefore, that heat as a quantity is not essential to the commencement of the phenomenon of ignition. The substance, whether solid or gaseous, must possess those qualities which enable it to emit light radiations of a certain order—those which are particularly abundant at the more refrangible end of the spectrum produced by a source of white light.

If the composition of a sample of coal gas be given, the amount of oxygen (and therefore of atmospheric air) required to effect its perfect combustion is a matter of simple calculation. Let us consider the case afforded us by Dr. Frankland's analysis. As every two volumes of hydrogen require one volume of oxygen, the 51.8 volumes of hydrogen given in the analysis require 25.9 of oxygen. Every two volumes of marsh gas require four volumes of oxygen, and therefore 31.5 would require 63.0. Every two volumes of of carbonic oxide require one of oxygen, and therefore 8.9 require 4.4. Every two volumes of olefiant gas require six of oxygen, and therefore 7.7 require 23.1. The results of these four independent oxidations are expressed in chemical symbols, as follows:

$$H_2 + O = H_2O$$
$$CH_4 + 2O_2 = 2H_2O + CO_2$$
$$CO + O = CO_2$$
$$C_2H_4 + 3O_2 = 2H_2O + 2CO_2$$

On adding together these several quantities of oxygen, we find that 100 volumes of such common gas require 116.4 volumes of oxygen for their complete combustion. As every five volumes of air contain one of oxygen, it follows that the quantity of atmospheric air necessary to completely effect a like result is 582 volumes. In other words, one volume of gas of the quality under consideration requires nearly six volumes of air (5.8). I need hardly say that, in practice, larger volumes of air are necessary to carry on the ordinary process of combustion in an efficient manner, the surplus air assisting very materially in removing the products of oxidation from the points where they are produced. When atmospheric air is mixed with coal gas in the proportion of 2½ volumes of the former to one of the latter, the mixture can be ignited when issuing from an ordinary burner, and consumed in the same way as the undiluted coal gas. The character of the flame, however, differs from that produced by the pure coal gas in that it loses, in a very marked degree, its light-giving properties. This phenomenon has given rise to much experiment, and is the result of several influences operating somewhat differently. Their consideration is outside our present question. In the case of a mixture having the proportions I have just named, it is obvious that a considerable proportion of oxygen is needed for the complete combustion of the gas. This additional quantity is derived from the external air, as in ordinary cases. If we take a mixture of gas and air in the proportions needed for the complete combustion of the gas (and, in the case of the particular quality we have already considered, we shall require 6 of air to 1 of gas), such a mixture can be burnt under special circumstances, and is, *theoretically*, quite independent of any supply of oxygen from external sources. Such a mixture is explosive. Suppose, for instance, that a cubic foot of it be confined in a spherical vessel, and that a flame be applied to a portion of the gaseous mass; rapid combustion of the mixture would immediately follow with explosive violence. As it contains in its own substance the oxygen required to form the ultimate oxidation products, and as these are gaseous, and produced at an excessively high temperature in a very short interval of time, the pressure which they exert on the sides of the containing vessel is very great. One speaks in general terms of such an explosion as being instantaneous. Such, however, is not absolutely the case. A certain definite interval is needed for the completion of the action which has been commenced by the application of the lighted substance. In other words, the flame applied to the explosive mixture traverses its substance with a certain velocity. The proportion of gas and air now considered are those which we have deduced from the analysis. In practice, however, where explosive mixtures are needed, as in the modern gas engines, a larger proportion of air is required to yield the maximum explosive force, and in the case of ordinary common gas about 1 volume to 8 volumes of air furnishes the best results. We will consider the behavior of mixtures of gas and air in varying proportions subsequently. Let us for the present confine our attention to the behavior of a cubic foot of an explosive mixture when ignited in vessels of the same capacity but of different shapes. I have selected a spherical vessel as the starting point in our discussion, because it is symmetrical. When filled with an explosive mixture and fired, there is a greater pressure on each unit of area of surface than in any other vessel of the same capacity, because a less interval of time is necessary for the passage of the flame to every portion of the explosive mass. In order to realize the velocity of the passage of the flame through the explosive mixture, we must alter the shape of the containing vessel. A cylinder is the best adapted for our purpose. A cylinder a yard long and about 8 inches in diameter would have a cubical capacity of one foot, and when filled with the explosive mixture and fired at one end would not produce such a very marked effect as in the former case. A tube 2 inches in diameter would require to be about 16 yards long, and if filled with the explosive mixture and fired at one end as before, we should be able to distinctly realize the interval required for the passage of the flame from one end of the tube to the other. The explosive action would also be very considerably diminished. If we now take a tube having a diameter of half an inch, it would require to be 256 yards in length in order to hrve a capacity of one cubic foot, and if we were to take any convenient length of such a tube made of glass, and fill it with

the explosive mixture, on igniting it at one end we should observe that the flame would pass down the tube without giving rise to any explosive action, and at such a rate as to admit of its velocity being measured. There are two important influences tending to bring about this modification of the result. Firstly, but a small quantity of the explosive mixture is consumed in a short interval of time; and, secondly, there is the cooling effect of the sides of the tube on the gaseous products of combustion. Their temperature is never so high as when produced in large masses, because the cooling action of the sides of a cylinder is greater in proportion to its diminished diameter. This is easily shown by the following considerations. Taking the ratio of the circumference of a circle to its diameter as three (this has been done in former calculations), our first cylinder—namely, that having a length of 36 inches and a diameter of eight inches—gives 24×36 or 864 square inches as the area of its containing sides. In the last case where the ½-inch pipe must have a length of 256 yards in order to furnish the same cubical capacity, we find that the area of its containing sides is

$$3 \times .5 \times 256 \times 36, \text{ or } 13{,}824 \text{ square inches.}$$

The area of the sides of this ½-inch pipe is therefore 16 times greater than that of the shorter cylinder, and consequently every cubic inch of the explosive mixture consumed in the ½-inch pipe is exposed to an area of cooling surface 16 times greater than that which obtains in the other. By diminishing the diameter of the pipe still further, we should at length arrive at such a condition of things that the cooling influence of the sides would prevent the transmission of flame by the explosive mixture. The circumstances would then be such that the temperature of ignition of the explosive mixture could not be maintained by its own combustion.

We have assumed in these imaginary experiments with cylindrical vessels that the pressure of the explosive mixture in their interior is equal to that of the atmosphere, and in so doing have only partially considered the case. When the pressure is greater than that of the atmosphere, we bring a new feature into the discussion. Its bearing on recent events is most important.

The first determinations of the velocity of flame in an explosive mixture of gases were made by Professor Bunsen of Heidelberg. In the case of a mixture of oxygen and hydrogen in the proper proportions for complete chemical combination, the velocity of the transmission of flame through the mass of the mixture was found to be 37 yards per second, whilst in the case of a mixture of carbonic oxide and oxygen in their proper proportions, the velocity was less than a yard per second. Professor Bunsen further found that when such explosive mixtures were diluted with a gas which did not take any part in the combustion, or when there was an excess of either gas in the case of each of the simple mixtures just referred to, the velocity of propagation of the flame was diminished. The method of experiment adopted in these investigations was to force the explosive mixture from a reservoir through a long, narrow tube. The velocity of the gas stream was observed when it was just sufficient to maintain the position of the flame constant with reference to a point in the side of the tube. More recently Professor Mallard, of the French School of Mines, has extended this inquiry. He has made a number of experiments in a manner similar to that of Professor Bunsen, using mixtures of marsh gas (fire-damp), and air, and coal gas and air, in different proportions. We have already seen that two volumes of marsh gas require four of oxygen for complete combustion, therefore one volume requires 10 of atmospheric air to effect the same purpose. It is an interesting fact that the velocity of transmission of flame in such a mixture is less than the maximum possible. It was found that a mixture of one volume of marsh gas and 8½ of air gave the highest velocity, and this was a little more than half a yard per second. With mixtures of coal gas and air the velocity of transmission of flame is greater than with mixtures of marsh gas and air. This result would be anticipated on a consideration of the composition of coal gas and the results obtained by Professor Bunsen, which have just been referred to. Common coal gas contains about half its volume of hydrogen, and therefore its chief component, when mixed with air, furnishes a mixture the rapidity of inflammation of which is very high—in fact, much higher than that of a mixture produced by any one of the other components of coal gas and air. But in all the cases of explosive mixtures now under notice there is a relatively large quantity of inert gas present—namely, nitrogen—which diminishes the rate of inflammation as shown by Prof. Bunsen.

In M. Mallard's experiments on mixtures of coal gas and air, he found that with the particular sample of coal gas employed, the maximum rapidity of inflammation occurred with a mixture consisting of one volume of coal gas and five of air. This gave a velocity of rather more than a yard per second.

In a published lecture by Doctor Thorpe, of Leeds, on the theory of the Bunsen lamp, a summary of M. Mallard's observations is given.

I have taken the liberty of expressing the metres of the original table as yards;

Volumes of Air mixed with one Vol. of Coal Gas (Composition not given).	Rapidity of Inflammation in Yards per Second.
6½	0.308
6	0.672
5½	0.893
5¼	1.073
5	1.100
4¾	1.019
4½	0.806
3½	0.105

It is obvious from a perusal of this table that the velocity of propagation of flame in explosive mixtures of coal gas and air may vary very considerably. When the mixture consists of one of coal gas to seven of air, we may safely consider the velocity as being not greater than a foot per second; whereas if the mixture consists of 1 of gas to 5 of air, there would be a velocity of not less than 3 feet per second.

Let us now consider the bearing of these principles on every-day practice. Suppose an explosive mixture (1 of coal gas to 7 of air) to be placed in a suitable vessel, and in communication with the external atmosphere by means of a cylindrical pipe several feet, say 6, in length, and further suppose that the internal diameter of the pipe is half an inch. If the pressure of the explosive mixture be the same as that of the atmosphere, but little of the former will escape into the external atmosphere. That portion which does escape is due, firstly, to the fact that the explosive mixture is lighter than atmospheric air; and, secondly, to the superior diffusive power of the explosive mixture. At the most there would be but a slight smell of gas if an observer were to place his nose close to the extremity of the open pipe. On the application of a flame to the extremity of the open pipe the explosive mixture would ignite, and the flame would traverse the length of the pipe quietly with a velocity of about three feet per second. In two seconds from the application of flame to the open pipe the explosive mixture in the containing vessel would be ignited, and an explosion would almost immediately follow, the character and extent of which would be modified by the shape of the containing vessel and the total volume of the explosive mixture.

Now let us suppose that the explosive mixture in the vessel has a pressure which is greater than that of the atmosphere, and that this pressure is maintained constant by artificial means. The escaping mixture can be ignited as before; but whether it will give rise to an explosion in the containing vessel, or not, depends on the velocity of the stream along the ½-inch pipe. If the velocity be anything greater than three feet per second, the explosive mixture in the vessel will not be ignited; but if the velocity be anything less than three feet per second, the flame will pass down the pipe with a velocity which is the difference between the two velocities—namely, that of the transmission of flame by the explosive mixture, and that of the gas stream along the pipe. If the velocity of transmission of flame be three feet per second, and the velocity of the explosive mixture along the pipe and at its external orifice be 2 feet per second, then the velocity of the flame with reference to the sides of the cylindrical pipe will be one foot per second, and, consequently, it will require six seconds for the transmission of flame from the external orifice of the pipe to the mass of explosive mixture in the containing vessel. We can therefore express the behavior of explosive mixtures in a general way by saying *that so long as the velocity of the explosive mixture at the point or points where it escapes into the atmosphere is greater than the velocity of transmission of flame through the explosive mixture, there will not be an explosion in the containing vessel on the application of flame to the above point or points.*

It will be as well if we now consider what is the velocity of a stream of gas in our ordinary arrangements for burning common gas. It is usual to consume it at the rate of 5 cubic feet per hour per burner. Some burners within my reach are attached to a metal pipe, the internal diameter of which is 2-8ths of an inch. Using the same factors as in our former calculations, the length of such pipe necessary to hold 5 cubic feet of gas is 184,000 inches, or 5111 yards. Dividing this number by 3600 (the number of seconds in 1 hour), we obtain 51 inches, or 4.2 feet, as the velocity of the gas stream per second in the pipe, when gas is consumed at the ordinary rate. But the orifice of the burner itself is much less than 2-8ths of an inch in diameter, and therefore the velocity of the escaping gas at this point must be something considerably greater even than 4.2 feet per second. It follows, therefore, that if in our ordinary domestic arrangements there should be an accumulation of an explosive mixture of gas and air through a defect in the pipes, or other unforseen circumstance, there is no reasonable chance of the slightest danger arising from the application of flame to the explosive mixture escaping from the burner at the ordinary pressure. Were it otherwise, accidents might possibly occur.

We have now discussed at some length the conditions necessary to be maintained in order to prevent the ignition of explosive mixtures of gas and air in containg vessels when they are at the atmospheric pressure, as well as when they are at higher pressures. We have just seen that the possibility

of danger chiefly consists in the pressure being so slight as to cause the stream of the explosive mixture to have less than a certain velocity. If, under these circumstances, the pipe be wide enough to allow combustion of the explosive mixture to keep up its own temperature of ignition, the explosive mixture in the containing vessel must eventually be ignited. Now in ordinary practice the pressure of coal gas (we will not go so far as to say explosive mixture) may be determined roughly by the application of a light and there is no doubt that this practice is often adopted. In the case of vessels which *may* contain mixtures of gas and air, the application of flame in the ordinary way is most dangerous, especially if the pressure inside the vessel be nearly the same as that of the atmosphere. In the absence of that which is to be determined by the test—namely, superior pressure, there is every probability of an explosion following the application of the test itself. In order that a flame may be applied as a test of the combustibility or otherwise of the gaseous mixture, or to roughly determine its pressure, it is necessary that the pipe or jet should be specially constructed. By diminishing the diameter of the pipe, so as to make it very small, we prevent the possibility of flame passing into the interior of the containing vessel, and in order to compensate for the small quantity of gas or explosive mixture passing outwards through such small pipe, it is necessary to arrange a number of these in the form of a bundle. A compound tube made up of a number of very narrow tubes would then permit of the escape of sufficient gas, or of the explosive mixture, at a very low pressure, and flame could then be applied to the external orifice to indicate the character of the escaping gas, without any danger of ignition of an explosive mixture in the containing vessel. Such an arrangement has long been in use for burning explosive mixtures of oxygen and hydrogen. A simpler arrangement, and one which can be easily constructed, consists of a piece of metal tube, upwards of an inch in diameter, and several inches in length, packed with carefully-cut discs of fine wire gauze. The discs must fit the internal part of the pipe accurately, otherwise their function will be imperfect. In either case flame cannot pass backwards under any circumstances so long as the bundle of metallic pipes or the cylinder packed with discs of wire gauze is kept at the atmospheric temperature.

We have now to consider the conditions favorable to the production of mixtures of coal gas and air, and the laws which regulate their formation. Taking common air as the standard substance, the specific gravity of common gas ranges between 0.4 and 0.5. We may therefore regard it as possessing half the density of atmospheric air. It has weight, as is implied by its specific gravity, and is therefore subject to the laws of gravitation, like all material substances. When it escapes in atmospheric air, it tends to ascend, and this arises from two circumstances—firstly, the coal gas is the lighter of the two substances; and, secondly, both coal gas and air are examples of a fluid body. The particles of fluid are readily susceptible of change with reference to each other and to those of a second fluid when there are differences of specific gravity, or when pressure is applied, and the like. When a jet of unignited coal gas escapes in an ordinary way, the lighter gas particles ascend, in consequence of their freedom to move, not only with reference to themselves, but also with reference to those of atmospheric air. So far, therefore, as the laws of gravitation affect the gas and air particles, the former ascend to the upper portions of the apartment, displacing the heavier particles of air; and were there no other influence besides the laws of gravitation in operation, the gas particles would collect in the upper portion of the apartment unmixed with air. As a matter of common observation, we know that this separation of gas and air into distinct layers does not occur; and further, that when the gas and air particles are thoroughly mixed, either by natural process or artificially, there is no separation of gas and air into two layers on allowing the mixture to remain at rest. The lighter gas particles do slowly mix with the heavier particles in opposition to the law of gravitation, and in the course of time the former will be equally dispersed through the air of the apartment, supposing there to be no chance of escape for either gas or air. The lighter gas diffuses itself through the heavier air in obedience to certain laws. These we will next consider.

The Coal Supply of London.

One of the largest coal consumers in the world is the great metropolis, and though there are occasional interruptions to the growth, yet from year year the tendency of the consumption is upwards, if not steadily so. From eight to ten million tons of coal are yearly brought into the metropolitan district, and though a portion of this is sent out, yet the consumption of the metropolis is astonishingly large; and the growth of that consumption is one of the causes that have contributed to the increase of the output of coal in the kingdom, and which has added thirty million tons to the production of the kingdom within the last fourteen or fifteen years. One of the checks to the growth of the consumption of coal in London has taken place in the present year—a temporary one after a year of very marked growth—so that the present is not an unfair indication of the extent of that consumption, and of the sources of that supply of fuel for the fires of the great metropolts.

It is impossible to indicate the method in which the coals sent to London are used except in outline. It is certain that two of the largest consuming sources are for steam power and for the manufacture of gas. In comparison with that of the country as a whole, the consumption for the purposes of metallurgy is very small, and for manufacturing purposes it is less in proportion probably than in the Lancashire district, so that to the two methods of consumption that of the demand for household purposes will probably be the next greatest.

It is, however, clear that the consumption must increase; steam power is more and more used; and despite the electric light, the area for the use of gas is growing, both for purposes of heat and illumination, whilst the extension of the metropolis year by year, enlarges the demand on the coal-pits of the kingdom, and large as has been the addition to the quantity of coal needed to feed the fires of London, it is certain that in the future that growth will continue, if not with an increased rapidity.—London *Builder*, July 31.

Gas Explosion at Bilston.

On Tuesday, the 13th ult., the inhabitants of Bilston were somewhat alarmed by two explosions in Church Street, were fortunately unattended with any fatal results, the only sufferer in person was the manager of the company, who was at the time present with the workmen, and received from the upheaving of the soil a few slight scratches on the face.

The company's workmen have recently been engaged in this street laying a new main, and making the service connections as the work on the main progressed. On Tuesday, the upper part of the street had been finished, and the men were employed near the Market Place. Although the pipes had been laid and covered up, there was a strong smell of gas in front of the London Tea Warehouse. Mr. Gibbs having complained, one of the workmen, from instructions, commenced about ten o'clock to search for the escape, and proceeded into the cellar under the shop to examine the pipes, but failed to discover the place of escape. He then proceeded to examine a pipe in a small hole opposite the shop door, and upon the application of a light, a startling explosion occurred, followed by the upheaving of about sixty yards of road, and the fracturing of some water pipes. This explosion was, however, not in the mains, but in an unused surface-drain, which had received the gas escaped from a decayed pipe in front of the tea warehouse. Mr. Reeves (the manager of the company) at once directed a number of workmen to excavate to the broken water pipes; in doing so, however, a spark caused by the pick of one of the workmen produced a second explosion, but as the men were near the opening of the drain the effects were slight, no injury being done to anyone beyond a few scratches on the face of the manager, as before stated. The second explosion was, no doubt, caused by the gas escaping from the old pipes displaced by the first explosion. Prompt steps were taken to ventilate the old drain and repair the broken pipes.

The progress of laying the main was for a short time suspended, and there was a plentiful supply of gas as usual. No injury whatever was done to house property and, beyond the fright from the noise of the explosion to the inhabitants near, we are glad to think that all further fear soon passed away.—*Review of Gas and Water Engineering.*

A Test of a Fink Roof Truss.

At the Edge Moor Iron Works, near Wilmington, an extraordinary test of fabricated iron was made recently, which will attract the attention of engineers, architects and contractors throughout the country generally, on account of its value as a scientific experiment and of its being an uncommon occurrence now, a similar trial not having taken place in this country probably for years.

The test was applied to a Fink truss, a portion of the iron market house for the city of Georgetown, Demarara. When Mr. Nathaniel McKay, of Philadelphia, was negotiating with the authorities of that British Colony, several jealous English and Scotch bidders who were on the ground annoyed him by throwing all sorts of obstructions in his path, going so far even as to pilfer the ideas in his plan. Among other nonsense which they circulated was the libel that the mechanics of the United States could not construct a building of sufficient strength to stand the wear and tear of the tropical climate of Demarara and the occasional wind storms that visit that latitude. In order to refute this slander, the American bidder expressly stipulated that if the contract were awarded to him he would furnish a test, under the supervision of competent engineers, to prove that the roof trusses were in accordance with the specifications by an actual load of 25 pounds per square foot. Tests of this character are considered wholly unnecessary and super-

fluous in this country, and are not made, since by calculation the requisite sections of every member of the roof truss can be so readily determined. The proviso was placed in the contract however, and Mr. Charles H. Latrobe, the consulting engineer for the city of Baltimore, and an engineer of some note, was engaged to apply the test. There were also present Mr. W. M. Levering, of Wilson Bros. & Co., who drew the plan of the building; Mr. Volmar, of Baltimore, contractor for the corrugated and galvanized iron which will enter into its construction; Mr. George Sellers, superintendent of the Edge Moor Iron Works, and Mr. McKay. When everthing was in readiness the test was applied in the following manner:

Two trusses, each having a total span of 55 feet 1 inch between centers of end pins, were erected side by side in the yard of the works—in the position which they will occupy in the building—and then loaded with the great burden of 113,000 pounds of iron properly distributed at the several points of support, which represented the test load of 25 pounds per square foot, and for which the contract was stipulated. This was a strain of 9500 pounds upon each of the eight panels into which the truss was divided. These trusses were on the Fink system, with a height of 13 feet 10 inches, the total weight of each truss being 4650 pounds. Under this load the strain was so heavy as to cause two of the ends to sink several inches into the ground and to disturb the plumb.

This occurrence was owing to the fact that sufficient bases had not been bestowed, the Messrs. Sellers having been led to understand that a test of only 60,000 pounds was to be had. Notwithstanding this unexpected disadvantage for the truss, the deflection in the centre was shown to be but half an inch, whilst not the slightest weakness was found in any of its parts. The test was eminently satisfactory both to the engineer applying it, to the architect, the manufacturers and the contractor.—*Iron Age*, August 12.

Formation of Bars in the Mississippi.

Interesting figures which show where the islands and sand bars in the Mississippi River come from have lately been prepared. From a series of daily observations extending from the early part of February to the latter part of October, 1879, taken at St. Charles, Mo., under the direction of the United States engineer corps, it has been ascertained that the average quantity of earthy matter carried in suspension past that point by the Missouri River, between one foot of the bottom and the surface, amounts to 84,858 lbs per second, or 1,283,731,200 pounds each 24 hours. The matter thus carried along weighs, approximotely, 100 pounds per cubic foot when dry, giving an average of 12,837,312 cubic feet of earth each twenty-four hours during the entire year, enough to cover one square mile to a depth of nearly six inches. During the months of June and July the average quantity per 24 hours amounted to 47,396,448 cubic feet; enough to cover a square mile to a depth of one foot eight inches.

The maximum quantity observed for any 24 hours was on July 3, when it reached the enormous amount of 111,067,200 cubic feet, sufficient to cover a square mile to the depth of four feet. These figures do not take into account the material that is held in suspension within the lowest foot of the depth, or that which is being rolled along the bottom. If these quantities could be ascertained within any reasonable limit of approximation to correctness, there is no doubt but they would show an amount far in excess of that which has already been determined.

Dry Fog.

It has been frequently noticed that during fogs near large towns the air is not saturated with moisture, the dew point in one instance being as much as 10°C. below the temperature of the air.

Seeing the possible connection between this phenomenon and the fact that the evaporation of water is greatly retarded by its surface being covered with a film of coal tar, the author made a series of experiments on the comparative rates of evaporation of water, when freely exposed to a current of air, and when covered with a film of coal tar or of coal smoke. It was found that the film retarded the evaporation from 92.7 per cent. to 66.6 per cent.

The results of these experiments point out a condition of very common occurrence, competent to produce "dry fog," while they also explain the frequency, persistency, and irritating character of the fogs which afflict our large towns.—*Sci. Am.*

Effect of Use upon the Quality of Iron.

In the summer of 1878 Prof. Bauschinger superintended some repairs upon a chain bridge which had been built in 1829. He examined several of the links by various tests, and found that there was no evidence of any diminution in the strength of the iron, nor of any change in its structure or its elasticity during the use of nearly half a century to which it had been subjected. In 1852 von Pauli tested several bars for another bridge, which was repaired in 1878, when Bauschinger subjected some of the same bars to new tests.

He found that the mean strength was still the same, after twenty-five years' use, and that no change of structure appeared to have occurred since the time of von Pauli's original tests.—*Dingler's.*

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

The Gas Furnace.

Mr. Editor: Your timely editorial on the above brings to mind the gas furnace and setting of Dr. Schilling, in use at the Munich gas works, to which I called the attention of some of your readers in May last. A plate and description of the same, and the work done by it, may be found in the *Journal fur Gasbeleuchtung*, April 15th, 1880. It seems a simple, effective and economical furnace.

Articles upon it, by "Isca," have appeared in the *Journal of Gaslighting*, and are worthy of perusal. The dimensions of the retorts and settings occupied by this furnace, and the work done, are as under—

Dimensions.

Width of arch, 86 inches.
Height to crown from floor, 74 inches.
Size of retort, 102 inches long, 16 inches wide and 12 inches high.
Number of retorts to bench, 8

Work Done.

Seven and six-tenth tons of coal carbonized by one ton of coke used as fuel. Reduced to our standard caking coals, this means: each ton producing 42 bushels of coke weighing 1560 pounds. Seven and six-tenths tons of coal carbonized by 60.3 bushels of coke, or each ton of coal is carbonized by seven and ninety-three hundredths bushels of coke.

In other words there is left of saleable coke

42—7.93=34.07 bushels per ton.

The results from Saarbruck coal alone (a coal inferior, both in its yield of gas and quality of its coke, to our standard coals) were as under:

Gas made per retort	in 24 hours.....	9,100	cubic feet
" " setting	"	72,800	"
" " pound of coal	.....	4.83	"

It can readily be seen that carbonizing our standard caking coals, a setting of 8's, with retorts 15″×30″ and nine feet long, should make—

Gas per retort in 24 hours.....	16,000	cu. ft.
" setting "	128,000	"
" pound of coal	5.00	"
Candle power.....	16	

The gas producing capacity per square foot of retort house floor is thus more than doubled, and the great saving in labor even without a mechanical stoker is evident. It is not too much to say that in a gas works in this vicinity, located on tide water, erected so as to handle mechanically their coal and coke, using these furnaces, or others of well known construction, and with the other recent improvements between the retorts and gas holder, a thousand cubic feet of 16 candle gas can be placed in the holder, without taking advantage of naphtha as an enricher, which would considerably reduce the cost, for less than 30 cents.

The prices of materials being as under, coal $5.25 per ton, coke 8 cents a bushel, ammoniacal liquor 10 cents per ton of coal carbonized, tar to be used as fuel, and the lime to be revivified.

The economy of fuel is the great point calling for the adoption of the gas furnace. Coke is to-day as valuable here as fuel, and brings as high a price as in large European cities. The average price received for coke in London in 1878–79 was, I think, under $2 per chaldron, less than 5½ cents per bushel.

There is also a largely increased yield per pound, accompanied by an increased yield of candle feet, owing to the intense and uniform heat by which the charges are carbonized.

The advances made in the manufacture of coal gas, in the past five years, are indeed great; some are as follows:

The reduction of the labor account from 50 to 75 per cent. by the adoption of machinery, the reduction in the consumption of coke to 20 per cent. and under of that made, accompanied by higher heats and increased yields, the removal of the dip, the self-sealing lids, the hot scrubber or carburetter, and the revivification of lime.

Will the next five years show as much progress? The increased attention of intelligent gas makers, now liberally assisted by men of high scientific attainments, induce us to think and to hope so.

X.

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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THURSDAY, SEPT. 2, 1880.

Official Report of Examinations of Gas for two Weeks ending Aug. 28, 1880, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

1880. Aug.	Time of Day at which Test were made.	New York Gas-Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
		†	*	†	‡	*	†
16		23.94	19.20	28.14	20.68	18.06	27.89
17	Between	27.86	20.25	27.80	21.46	18.15	27.70
18	9.30 A.M.	25.83	19.51	26.74	22.34	18.31	27.42
19	and	25.62	19.49	27.24	20.30	18.36	27.62
20	1 P.M.	25.19	18.87	25.51	21.21	18.20	28.24
21		25.27	19.05	26.27	21.90	18.06	28.07
	Average	25.12	19.39	26.95	21.32	18.19	27.82
23		24.90	19.34	26.42	21.13	18.25	28.28
24		24 59	19.11	27.04	20.92	18.14	28.10
25		23.27	20.53	26.93	20.96	18.13	29.40
26		24.60	20.20	27.79	19.90	18.42	27.88
27		23.02	21.08	25.77	20.30	18.32	28.80
28		24.00	20.50	25.60	21.64	18.14	27.89
	Average	24.06	20.12	26.59	20.80	18.17	28.39

* Five foot lava tip with check.
† Bray's slit union, No. 7.
‡ Bray's slit union, No. 6.
E. G. LOVE, Gas Examiner.

Naphtha Lamp Explosion.

Walter Harrison, employed as a street lamp lighter by the Pennsylvania Globe Gas Light Company, went over his route Tuesday morning as usual. In front of T. M. Williams' residence, on Park avenue, he began to pour the naphtha into the reservoir, not noticing that the lamp was still burning. As soon as the liquid came in contact with the flame it ignited, and the burner was speedily melted; then an explosion occurred, blowing off the top of the lamp shattering the glass, and setting fire to Harrisons clothes. He ran toward his home with his coat in a blaze. Mrs. Williams saw him and begged him to stop, but as he did not heed her, she ran after him and tore off the burning coat. She then took him back to her house and dressed his wounds. One hand is very badly burned, and his injuries would have been much more severe had it not been for the presence of mind and prompt action of Mrs. Williams.—*Wilkes-Barre Exchange*, Aug. 14.

Deposit in Tubing From Gas Well.

For some years past the tubing of the gas well which supplies the Leechburg (Pa.) Rolling Mill with fuel has been gradually filling up with a rather remarkable substance. In the past seven years this substance has accumulated to such an extent that the diameter of the well inside the tubing has decreased from 5 to 2½ inches.

The substance has formed in regular layers all around the tubing. It is not very hard while in the well, but becomes almost as hard as marble upon exposure to the air. In color it is pure white. The chemical analysis made of it by Dr. Otto Wuth, of Pittsburgh, is as follows:

Carbonate of lime	94.84
Carbonate of magnesia	4.76
Sulphate of lime	.13
Peroxide of iron	.27
Total	100.00

J. H. Luther, of Kansas City, upon whom the oil men are accustomed to fall back in difficult cases, has been employed to clean out the tubing, which he proposes to do by means of instruments of his own invention.—*Iron Age.*

Marking Tools.

Much trouble can often be saved by marking tools with their owner's name, which can be easily and inexpensively done in the following manner:—Coat over the tools with a thin layer of wax or hard tallow by first warming the steel and rubbing on the wax until it flows, and let it cool. When hard mark the name through the wax with a graver, or any sharp-pointed instrument, and apply nitric acid. After a few moments wash off the acid, and wipe it with a soft rag, when the letter will be etched into the steel. —*Exchange.*

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
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34 PINE STREET, NEW YORK CITY.
SEPTEMBER 2, 1880.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	*Par.*	*Bid.*	*Asked.*
Gas Co.'s of N. Y. City.				
Central	466,000	50	60	70
Harlem	1,800,000	50	72	77
" Bonds	170,000			103
Manhattan	4,000,000	50	188	190
Metropolitan	2,500,000	100	140	142
" Scrip	$1,000,000	...	100	103
Mutual	5,000,000	100	70	75
" Bonds, gold	900,000	1000	100	—
Municipal	1,500,000	100	170	175
" Bonds	750,000		106	110
New York	4,000,000	100	102	104
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	106	110
Citizens	1,200,000	20	60	65
" S. F. Bonds.	320,000	1000	100	105
Fulton Municipal	1,500,000	100	70	80
Peoples	1,000,000	10	38	42
" Bonds	200,000	...	90	95
" Scrip	250,000	...	75	85
Metropolitan	1,000,000	100	65	75
Nassau	1,000,000	25	50	57
" Ctfs.	700,000	1000	85	95
Williamsburgh	1,000,000	50	70	75
" Scrip		...	98	103
Kings Co	135,000	100	60	70
" Bonds	40,000	—	—	—
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	75	80
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N.Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md.	2,000,000	100	185	190
" Ctfs., gold	1,000,000		—	103
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.				190
Consolidated, Balt.			87	88
" Bonds			109	110
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	114	120
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind.		100	...	—
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn	700,000	25	120	125
Hempstead, L. I.	25,000	100	...	—
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150.000	40	117½	
Jersey City	750,000	20	150	160
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	100	...
Lewistown Maine	400,000	100	70	80
Laclede St Louis Mo.	1,200,000	100	93	96
New Haven, Conn		25	120	140
Oakland, Cal.			34	35
Peoples, Jersey City		...	50	60
" " Bds.				5
Plainfield, N. J.	80,000	100	—	105
Perth Amboy		25	—	95
Pittsfield, Mass.			120	130
Rochester, N. Y.		50	70	80
" Citizens		100	50	60
Rondout & Kingston			75	80
St. Louis Missouri	600 000	50	300	—
Stillwater, Minn.	50,000	50	—	26
Saugerties, N. Y.	15,000	100	95	100
San Francisco Gas-Co., S. Fr'isco Cal.			71	71½
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C.	1,500,000	20	170	185
" Scrip	500,000	20	100	110
Woonsocket, R. I.	150,000	100	80	...
Wilmington, Del.		50	174	...
Yonkers		50	—	70
Montreal, Canada	2,000,000	100	139	140

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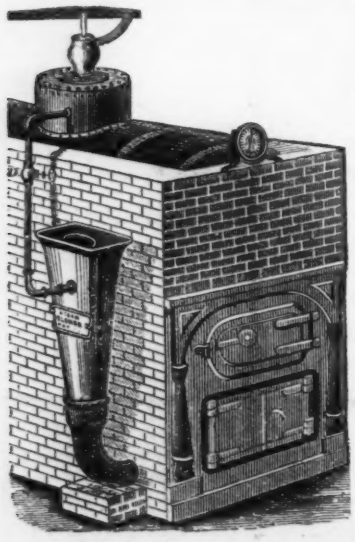

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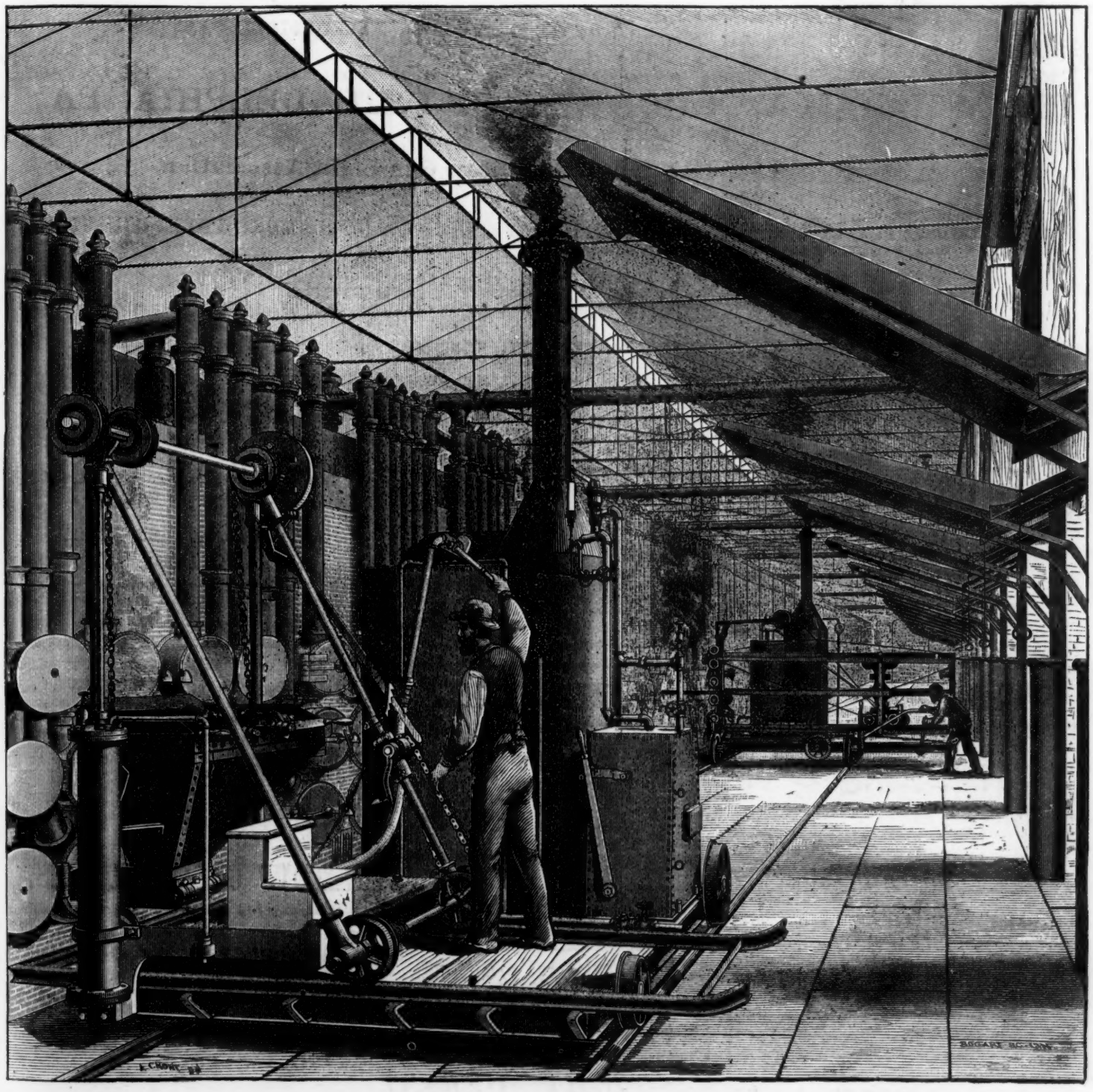

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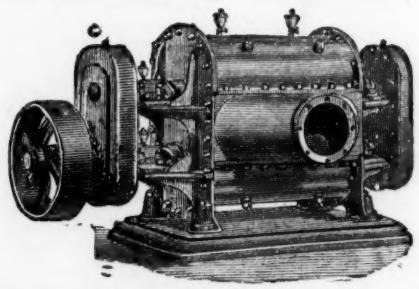

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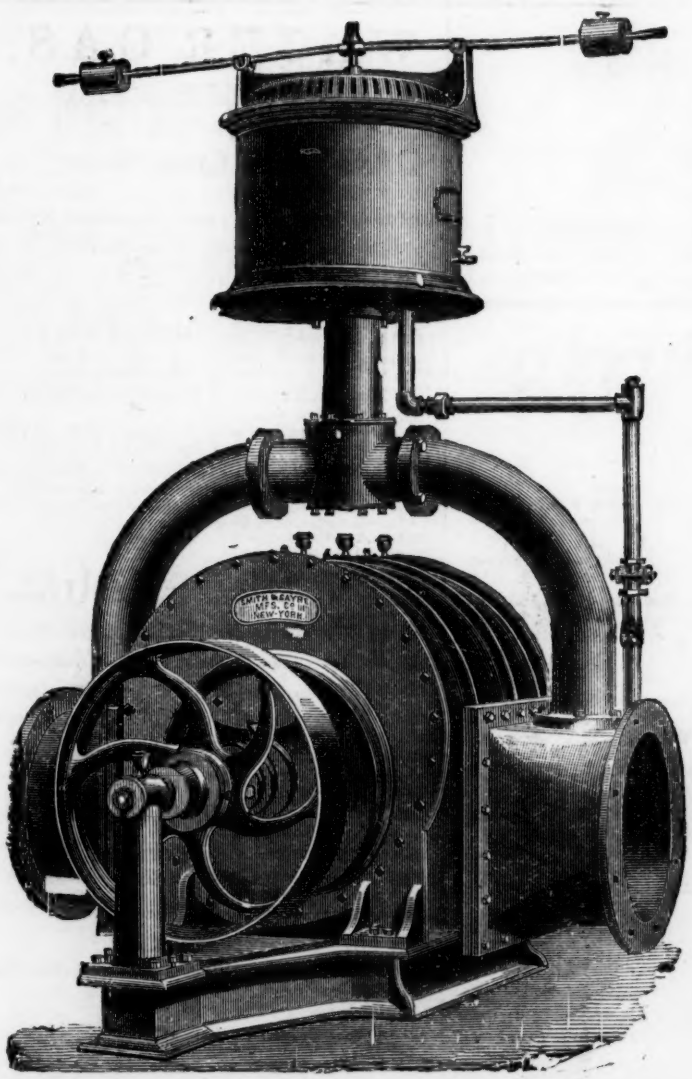

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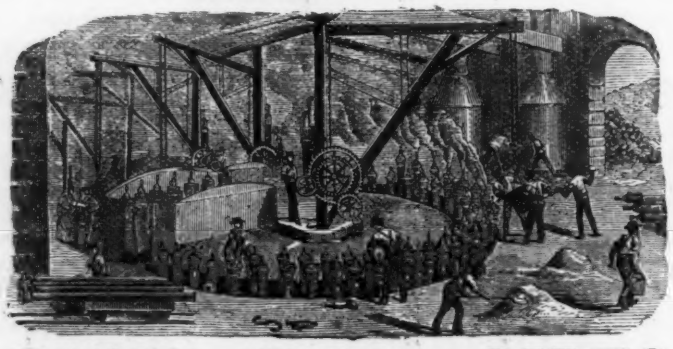

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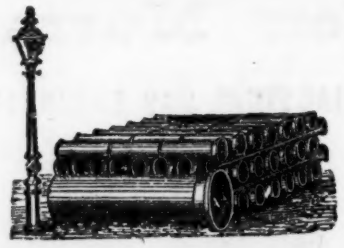

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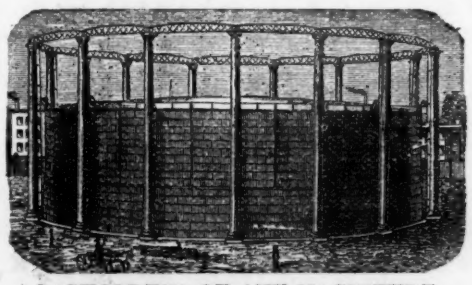

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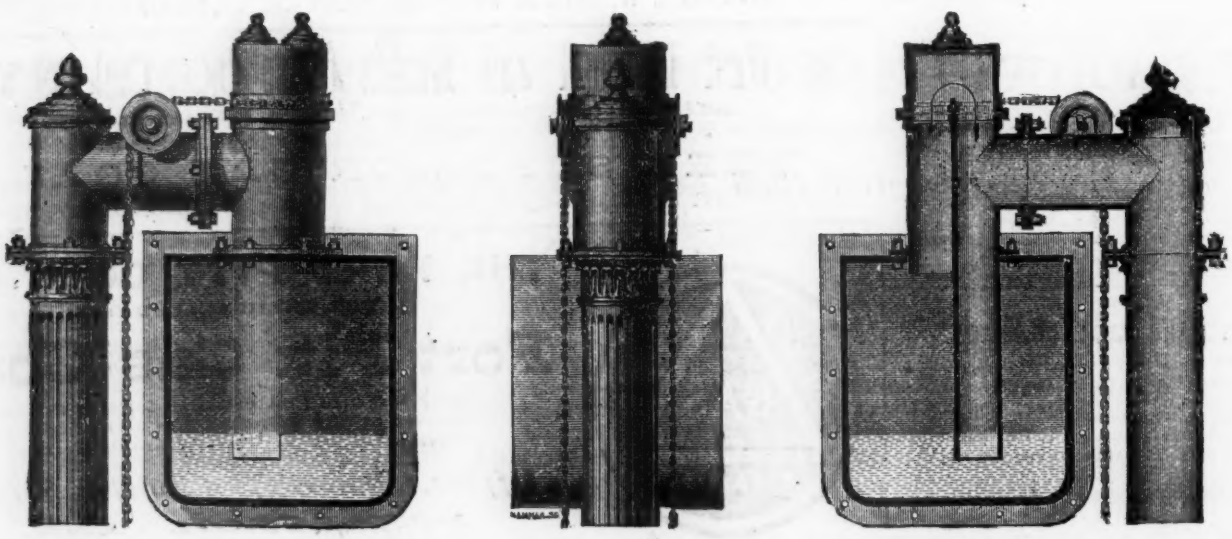

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